Oral Pathology and Practice.

A TEXT-BOOK FOR THE USE OF STUDENTS IN DENTAL COLLEGES AND A HAND-BOOK FOR DENTAL PRACTITIONERS.

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SECOND EDITION,

REVISED, ENLARGED, AND ILLUSTRATED.

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TO

My beloved Associates in College Work,

AND TO

My Boys,

THE MEMBERS OF THE VARIOUS CLASSES WHO HAVE
BEEN UNDER MY INSTRUCTION, AND WHOM
I HAVE SOUGHT TO SERVE,

THIS WORK

IS AFFECTIONATELY INSCRIBED.

PREFACE TO SECOND EDITION.

The kind reception accorded the first edition of this book by the dental profession was a matter of almost as great surprise as gratification. The author did not anticipate that within two years it would be exhausted, and a second—which is greatly belated—demanded, for works of this kind do not appeal to the general public and are restricted in their sale.

At the outset the publishers strongly urged that the text be properly illustrated with cuts, but the author had not sufficient faith in his venture to increase the necessary cost of the book by the addition. The fact that those interested have generally approved his efforts leads him to put forth yet greater exertions to make the volume more worthy their confidence.

Accordingly it has been thoroughly revised, not a chapter now reading as it did originally, while much new matter has been added and many illustrations have been introduced, the principal ones being original with this work. The author has endeavored to profit by the honest criticisms of the reviewers of the first edition, and sincerely hopes that some of its faults have been eliminated.

He offers this riper fruit in the hope that it will not only be more palatable and easy of digestion than that which was plucked earlier, but that it will also prove nutritious and professionally healthful. He trusts he may not be thought presumptuous when he commends it to the student as a text-book, to the teacher as a help in his arduous duties, and to the practitioner as a work for daily reference.

W. C. B.

208 Franklin St., Buffalo, N. Y.,
October, 1900.

PREFACE TO FIRST EDITION.

THIS book is not a treatise, and surgical or operative procedures form no part of its scheme. In writing it the first object has been to condense, not to amplify, that it may be published at as low a price as possible. With this end in view, cuts have been excluded, desirable as they might in some instances be. The work has thus been kept within the limits of a manual.

It has been the aim of the author to consider as succinctly as is consistent with clearness the functional derangements of all the oral tissues that properly fall within the compass of a broad dental practice. In addition to this there are certain constitutional disorders, the effects of which may be observed in and about the oral cavity, which have not as yet been incorporated into our specialty, and perhaps never will be, but of which it is essential that the dentist should have sufficient knowledge to enable him to make a clear diagnosis, even if he should not purpose active remedial measures. Such disorders as facial paralysis, syphilis, and tumors have therefore been given a general consideration, but practitioners who wish to make a more exhaustive study of those subjects are referred to special works upon them.

It should not be expected that a writer will blindly and unreservedly follow even accepted practice when in his opinion it is founded in error; such a course would make of him a mere echo, and would inhibit originality and progress. If, therefore, the author has advanced his own ideas upon subjects concerning which there is a difference of opinion, he believes them entitled to candid consideration in the light in which they are presented. If not found in harmony with clinical experience and observation, they disprove themselves.

It is only within a few years that Pathology as a separate study has been made a distinct part of the curriculum of our colleges. The treatment of a few of the more pronounced pathological conditions has always been included in the course of lectures upon Operative Dentistry, or in that of Materia Medica and Therapeutics, but the subject has been made rather incidental than foundational. With the growth of dental practice and the expansion of

the course of instruction in our colleges, a more extended consideration of the treatment of complications naturally attendant upon dental degenerations becomes a necessity in our best schools. Dentists are reasonably plentiful, and the multiplication of institutions devoted to their training is believed to promise an even more abundant supply. The complaint that the profession is getting uncomfortably crowded arises from the old graduates, as well as from those who have been deprived of the advantages of scholastic training.

The remedy for these conditions can only be found in the deepening of the stream—in the enlarging of the field of practice by incorporating with the methods of the past (the mechanical and operative procedures which have already been carried to such a high state of perfection) the treatment of the diseases that properly fall within the province of the oral physician, and the making of Oral Practice a true specialty of medicine.

For some years the author has annually delivered before his classes in dental colleges from fifty to sixty lectures upon pathological and morbid functional and structural conditions in the oral cavity and the tissues immediately connected with it, in which there has been attempted nothing of instruction in constructive, operative, or manipulative dental work. This has tended to open for students a field insufficiently cultivated by dentists. It has enlarged their opportunities, added to their emoluments, and given to them a better professional status.

But in this line of teaching he has been seriously handicapped by the absence of proper text-books. Excellent treatises were in existence, but none of them was exclusively devoted to the everyday work of either student or practitioner. They included other branches of dental science, and while, as works of reference and as text-books for advanced members of the profession who desired to make special studies in scientific fields, they were much better adapted than a work of this kind can possibly be, yet as handbooks for students in colleges and as everyday manuals for those who sought help in the hourly recurring complications of office life they were too voluminous.

In the time of Hippocrates it was possible to comprise in one volume all that was known of medicine. Many of our older practitioners can call to mind the days when the whole art of den-

tistry was imparted by a preceptor in a few easy lessons. One man might then be universally recognized as the highest authority in the whole field. Now, a complete knowledge of any one of the distinct branches of medicine demands a post-graduate course after four years of general study, while three years in a dental college are scarce sufficient to enable the student to master the basal principles of our greatly extended oral practice. Not alone medicine, but dentistry is divided into specialties, and already there are among us those who give their exclusive attention to Operative or to Prosthetic work, to Oral Surgery, to Odontothorsis or to Odontotherapy. The tendency seems to be toward the teaching of each branch in separate classes, with distinct text-books for the several departments. The present work grew out of that seeming drift, and the germ of its existence lay in the notes of lectures upon the subjects considered.

The book could easily have been expanded into greater dimensions, but that would have limited its usefulness among those for whom it was specially prepared. Extended abstracts of the writings of others might have been included with profit, but that would have swollen the volume beyond the limits set for it, and have added to its cost. Besides, a book should have a distinctive individuality, a personality as pronounced as that of the successful teacher, and without this it is usually as insipid as is the man or woman who possesses no distinguishing peculiarities. So it is perhaps better that it should be marred by some of the many faults of its author rather than be without any special traits at all.

W. C. B.

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ORAL PATHOLOGY AND PRACTICE.

CHAPTER I.

GENERAL CONSIDERATIONS.

The study of disturbed, as well as of normal systemic conditions, necessarily commences with the consideration of Function. Health and sickness (ease and *dis*-ease) are dependent upon the activities of the organs of the body. In the former condition all are harmoniously working together, each accomplishing its proper task in the best manner and at the right moment. In the latter there is a disturbance of the interdependent bodily relations through the inaction or the mal-action of some organ or set of organs, induced by malnutrition, by unsanitary conditions, or by external interference.

Function is the action of an organ, or of a complete set of organs. The function of digestion implies the proper action of all the organs of the digestive tract, and the perfect accomplishment of this requires that each of them shall be in that state of health which is secured only by the normal action of all combined. The function of every organ is in some way dependent upon that of others, and a state of complete bodily health implies perfectly harmonious relations in all its different parts.

The function of insalivation demands that all of the salivary glands shall be in a normal condition, secreting healthy saliva, and that the saliva shall be properly mixed with ingested food. The secretion of the mucous glands is viscid and contains mucin; that of the parotid is largely serous and contains ptyalin, while that of the submaxillary and sublingual glands is mixed in character. Unless all these secretions are combined the saliva will lack some ingredient, and cannot perfectly perform its office. If, then, the action of any gland is not normal the saliva is modified, and this may interfere with the function of digestion, proper assimi-

lation may be inhibited, every tissue of the body may lack nourishment, and thus from a disturbance in one apparently unimportant organ every other in the system may suffer.

Physiology is the science of normal function. Its proper study demands a knowledge of the structure of the organs concerned. It is not confined to man, or even to animal life. Wherever there is vitality, growth, organs (that is, in all organic matter) there are certain laws that govern the functional activity of the organism, and the study of these laws is called Physiology.

Physiology is divided into animal and vegetable physiology. It may again be subdivided until the functional activity of each of the various orders of animal and vegetable life is specially considered.

Pathology is the study of perverted, abnormal, or diseased function. Its comprehension must be based upon a knowledge of healthy action. The study of pathology may be divided in the same manner as is physiology. Wherever there is normal function there may be diseased or perverted action of the tissues or organs, if their activity is in any way disturbed. So we may have animal or vegetable pathological action, and we may study this aberration in any class of animals or vegetables, even in any separate organ or tissue; thus we speak of human or animal pathology, and of pathological conditions of the digestive apparatus, the kidneys, the pulmonary tissues, the oral cavity, the nails, the teeth, the hair, etc. This unrestricted nature of the study must always be kept in mind, and the fact that in the consideration of the diseases that are incident to man we are but making an examination of a small portion of the great field of perverted activity should never be lost to sight.

Oral pathology is but a branch of disturbed human function. While we may make special inquiries into its character, it can never be wholly segregated from its connections, but must always be considered in its relations to impaired conditions of other organs, because its initial lesion, or point of origin, may be in them, and a cure may only be brought about through a return of those connected organs to a true state of physiological activity. There is no proper study of the oral tissues or organs aside from their functional association with other tissues and organs.

A physiological state may be changed to a pathological condition by any derangement of function. The modifying influences which induce this may be classed as follows:

1. *Perverted nutrition (or malnutrition).*
2. *Unsanitary surroundings or environments.*
3. *External interference.*

Their importance as disturbing factors and the gravity of the functional disarrangements induced by them are in the order given.

Malnutrition means the improper nourishment of the tissues or organs. It may primarily depend upon improper food, a lack of food, or upon imperfect action of the organs of digestion and assimilation. A degenerate condition of these organs is usually brought about either by impaired nutrition or unhealthy environment, and it may therefore be considered as a secondary cause.

Unsanitary or unhygienic conditions are those that interfere with proper functional activity, by means of some disturbing element or influence, such as

a. Contamination of the air that is breathed, or the food or drink that is taken.

b. Subjection of the organs and tissues to improper extremes of temperature.

c. Promotion of the proliferation and growth of parasitic or disease-producing organisms.

External interference has reference to factors not primarily connected with functional disturbances. It includes wounds and injuries, the influence of excessive heat and cold, the active agency of corrosive poisons, and such-like extraneous causes.

CHAPTER II.

BACTERIOLOGY: CLASSIFICATION.

Modern pathological science is largely founded upon a knowledge and study of the bacteria—a subdivision of the fungi. The influence of these organisms upon the body is so overwhelming that it is impossible to comprehend pathology without a comprehension of their character and action. So many of the diseases most

destructive to man are caused by them, that modern medical science is largely based upon their study. Notwithstanding the fact that they can only be seen by the aid of the higher powers of the microscope, and that even then some of them are absolutely indefinable to vision, they work the most important changes in matter. Were it not for their influence the world would become uninhabitable through the using up of organic matter, which would become permanently incorporated in unchangeable compounds and the pabulum for animals and vegetables thus exhausted.

The office of the fungi seems chiefly that of destruction. By their growth they decompose organic matter in which function has ceased, and return its elements to nature, to be again built up into other structures by varying functional activities.

Different names have been given to these organisms by different pathologists, though all have the same general signification.

a. *Micro-organism* means *a small body.*

b. *Microbe* signifies *a small life.*

c. *Bacterium* (plural *Bacteria), a small staff.*

d. *Bacillus* (plural *Bacilli), a small rod.*

It will be seen that the first two and the last two names are practically synonymous. While all these terms may here be used interchangeably, micro-organism is perhaps as comprehensive as any, although it has no strictly scientific significance. All of these bodies that come within the field of the pathologist are microscopic; hence to speak of them as micro-organisms is more appropriate than to call them fungi, the latter term including many organisms that are merely parasitic upon other vegetable growths, while many of the fungi are not microscopic and have no pathological significance.

In general classification the various divisions and subdivisions of matter are usually denominated as follows: Matter is divided into Grand Divisions; these into Kingdoms; Kingdoms into Sub-Kingdoms; Sub-Kingdoms into Classes; Classes into Orders; Orders into Genera, or Families; Genera into Species, and Species into Varieties.

The fungi have been differently classified by various observers, each having based his arrangement upon certain special characteristics. That of Miller, in his "Micro-organisms of the Human

Mouth," is perhaps best adapted to the needs of students of oral pathology, and it is therefore accepted as the standard for this work. The following table will give a clear idea of it:

Matter

Organic — Inorganic

Animal — Vegetable

Cryptogams (Flowerless plants, propagating by spores) — Phanerogams (Flowering plants, propagating by seeds)

Thallogens, or Thallophytes — Leafy Cryptogams, (Ferns, Mosses, etc.)

Lichens — Fungi — Algæ

Screw forms	*Rod forms*	*Round forms*
Vibriones (undulating)	Bacilli (straight rods)	Micrococci (small cocci)
Spirillæ (rigid)	Clostridium (spindles)	Macrococci (large cocci)
Spirochetæ (flexible)	Leptothrix (threads)	Diplococci (double cocci)
		Streptococci (chain cocci)
		Staphylococci (group cocci)

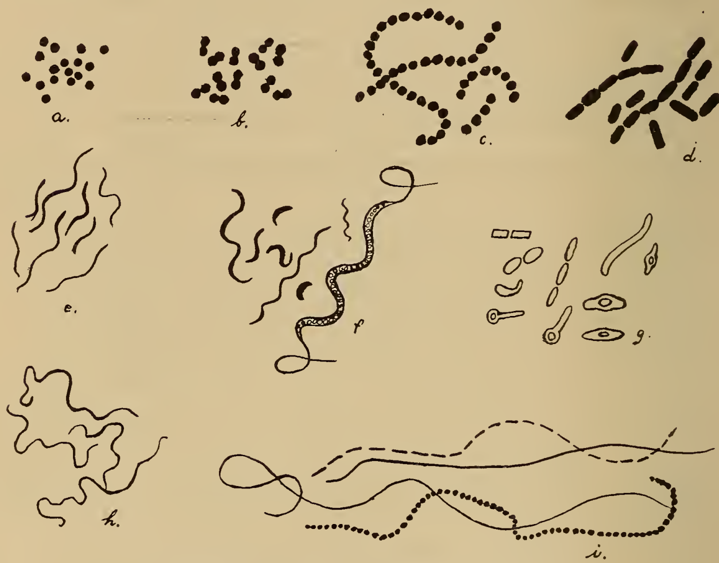
Organic matter is that which is the product of function, or growth. Everything that has organs, or in which function exists or has once existed, is organic.

The organic world is divided into two great kingdoms, the Animal and the Vegetable. Each individual member of these great divisions has its organs and its tissues; function exists in each as long as there is vitality, or life. Death is merely the cessation of function, and the physicist makes no other distinction between the dead and the living than the presence or absence of functional activity.

The food of these two kingdoms materially differs. The animal can assimilate nothing except organic matter. Thus the Graminivora live upon vegetables alone, or matter that has been but once organized, and they require a complicated digestive system to extract the comparatively small amount of pabulum for their

tissues which it contains. The Carnivora feed upon the animal kingdom, or matter that has been twice organized; first into the vegetable and then into the animal. Their digestive apparatus is comparatively simple, because of the concentrated nature of their food. The Omnivora, to which division man belongs, can subsist upon either, and their digestive organs, while more complex than those of the Carnivora, are considerably modified from those of the Graminivora.

FIG. 1.



DIFFERENT FORMS OF BACTERIA. (After Miller.)
a, Micrococci. *b*, Diplococci. *c*, Streptococci. *d*, Bacilli. *e*, Vibriones. *f*, Spirillæ. *g*, Clostridium. *h*, Spirochetæ. *i*, Leptothrix.

Only organisms that belong to the vegetable kingdom have the power of living upon inorganic, or unorganized, matter. Certain of the vegetable fungi are unable even to do this, but must have the food organized before they can assimilate it, as must all members of the animal kingdom.

Inorganic matter is that which exists as it was first created. This earth, when it left the hands of its Creator, must have consisted exclusively of inorganic matter. When, in due process of time, the first organic cell was created, and endowed with the power to

adapt itself to changing environments and to perpetuate its species—in other words, was invested with function—its food, or pabulum, must have been derived from the inorganic creation. But only the vegetable kingdom has the power to assimilate or organize this matter, or to subsist and grow upon that which is as it was primarily created. Hence the vegetable was first in the order of organic creation, and all organic matter, which is the product of function and was primarily derived from the inorganic, must have originally been the result of vegetable action.

No animal can utilize for trophic, or digestive, purposes any inorganic matter whatever. This is a law of the creation. All the mineral elements that enter into the composition of our teeth, bones, etc., must be obtained from organic sources. That is, the calcium, phosphorus, iron, etc., of our tissues must have been derived from matter that had first been built into other life. Inorganic matter may be utilized in the system as medicine, but it will be extruded in the same form in which it entered; it cannot be built up into the tissues. Even water, which forms so large a proportion of all organic bodies and which is itself inorganic, is not, strictly speaking, trophic or nutritional, but is interstitial. It holds in solution many salts, forms a part of all crystalline structures, and is a necessary constituent of the body, though not of the elements of the tissues themselves. It necessarily follows, then, that in the order of the developmental history of the world, the vegetable must first have had a being, to provide food for the animal.

The vegetable kingdom is divided into the classes Phanerogam and Cryptogam.

The Phanerogams include all those plants which have blossoms and which are propagated by seeds. The roots of some phanerogams, as the potato, enlarge into tubers, from which new plants may be grown, but their real generation is from seeds. Most of the plants with which we are acquainted belong to this class. It is the seeds and the tubers of the phanerogams that form the principal vegetable food of man.

The Cryptogams never blossom, and their propagation is by spores, or minute embryos of the plant itself. As the potato may be propagated from divisions of the root or tuber, so do many of the cryptogams grow from divisions of the organisms themselves, but primarily their origin is from spore-cases.

The Leafy Cryptogams are not microscopic in their character, and they have distinct branches and stems. But, like all of their class, they grow from spores. The leafy cryptogams include the ferns, the mosses, and some of the lichens.

The Thallogens, or Thallophytes, belong to that division of the cryptogams that are unicellular and simple in their structure. They are without leaves, stems, or branches. They are divided into Fungi, Algæ, and Lichens.

Fungi are without chlorophyll (the green coloring matter of plants), and live only upon organic matter. They are found as the parasites of both the animal and vegetable kingdoms.

Algæ contain chlorophyll, but live upon inorganic matter. They are usually found growing in the water.

Lichens partake of the character of both the fungi and the algæ. They may or may not contain chlorophyll, and they may live upon either organic or inorganic matter, according to their species. They are usually found attached to some inorganic matter, and obtain their subsistence from the air.

It will be observed that only the fungi can be of interest to the pathologist, for the algæ do not grow upon organic matter, and hence will not be found parasitic in man, whose structure is organic, while the lichens have no pathological significance.

The Fungi are divided according to their shape, into round, rod, and screw forms.

The round, or coccus forms, are subdivided into the macrococci, or large cocci, the micrococci, or small cocci, and the diplococci, or double cocci, the streptococci, or chain cocci, and the staphylococci, or those which grow in clusters, like a bunch of grapes.

The rod forms are divided into the bacilli, or straight rods; the clostridium, or spindle-shaped, and the leptothrix, or thread-like forms.

The screw forms are divided into the vibriones, or undulating screws; the spirillæ, or rigid, and the spirochetæ, or flexible screws.

This subdivision as to form is for convenience, and has no special pathological significance. (See Fig. 1.)

Classed according to their action the fungi are divided into other groups, such as Zymogenic (fermentative), Pathogenic (disease-producing), Chromogenic (coloring), Aerogenic (gas-

forming), Saprogenic (putrefactive), Pyogenic (pus-producing), Saprophytic (decomposing), etc.

CHAPTER III.

FERMENTATION.

A ferment is any substance which has the ability to bring about the molecular oxidation and decomposition or disintegration of the carbohydrates and proteids, or nitrogenous and albuminous compounds. As these are the substances which are chiefly concerned in the composition of organic matter, it will be seen that the process is of overwhelming importance, and that without its comprehension the student is not prepared to consider any of the constructive or destructive changes of the body.

Fermentation may be defined as the change brought about in such organic medium by the presence of a ferment. It is only within a recent period that its true nature has been comprehended. It was formerly ascribed to what was called catalytic action. It is now known to be induced by a special organism or substance, and its phenomena are those produced by the decomposition of the medium in which the ferment is growing, or exhibiting its energy.

There are organized and unorganized ferments. The action of the so-called unorganized ferments does not essentially differ from that of the organized. In either the process consists in a solution of the bonds of constructive affinity and the formation of new compounds—in active molecular derangements and rearrangements. With the organic ferments this is brought about through the functional activities of simple individual organisms, while the inorganic ferments are formed by and owe their activity to a compound, complex structure, made up of functionally united organs, each displaying its activities for a common purpose.

The organized ferments are certain of the micro-organisms whose growth or proliferation is by the assimilation of the elements of the fermentable substance. This they have the power to decompose, as a cabbage disintegrates and resolves into its elements the soil in which it grows.

The unorganized ferments are the enzymes, or those of diges-

tion. The gastric and intestinal juices, the saliva, etc., contain ferments that decompose and change the fermentable foods, and reduce them to a condition in which they may be assimilated, or built into tissue.

It is only fermentable organic matter that can be thus digested and assimilated. Inorganic matter is incapable of fermentation, and hence cannot serve as food for any of the tissues of the animal.

The classification of the fungi shows that they are as distinctly vegetable as is a potato or a geranium. The fact that they belong to a different order, and are cryptogams instead of phanerogams, does not change this. They require for their development the same essential conditions and elements. They must have the proper soil, or menstruum, in which to proliferate, or grow, as must the flowers of the garden or field. They require a proper amount of moisture, as does corn or wheat. They demand a fitting temperature, and are destroyed, or cease to vegetate, when that is either too high or too low, as are grass, trees, and shrubs.

The media, or soils or materials in which the different species of micro-organisms grow, are as various as are the fungi themselves. Some require a sugar solution, made from the fermentable sugars formed by the change of starch into the so-called grape sugar. Some demand an infusion prepared by steeping vegetables belonging to the phanerogams. Some grow only in gelatins. Others exist only in the tissues, or extracts of the tissues, of animals.

The temperature best adapted to their growth varies with the organism. With those that live in the tissues, that which is normal to the body is also normal to them.

The growth of the organisms, although primarily from spores, goes on in various ways.

Segmentation is the spontaneous division of a micro-organism into segments, or sections. Each is complete in itself, and each in turn subdivides into others.

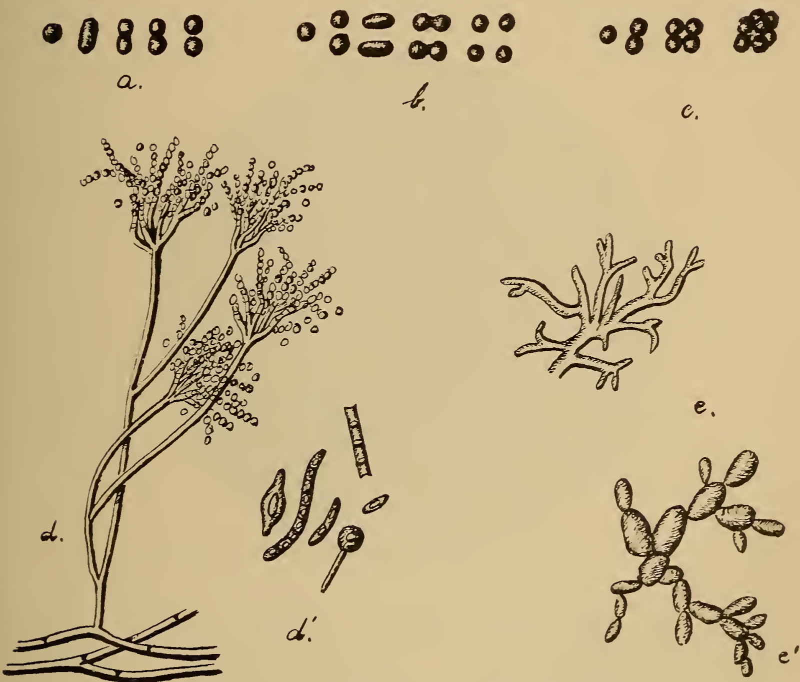
Gemmation is the process of proliferation by budding. This is the growth of one organism out of another, and its final separation from the parent.

Fission is the division of an organism into two or more parts by a constriction of its body. This contraction gradually deepens until the separation is complete.

Spore formation occurs when in certain stages of its life-history

an organism undergoes special changes. In these the interior breaks up into exceedingly minute embryos, which are liberated and dispersed by the bursting of the external envelope. Many of the organisms which at certain stages of their existence proliferate by means of segmentation or gemmation, after a definite time break up into spores. Something analogous to this exists among

FIG. 2.



METHODS OF PROLIFERATION OF THE BACTERIA.

a, *b*, *c*, Fission or segmentation. *d*, *d*[1], Sporulation. *e*, *e*[1], Gemmation or budding of organisms.

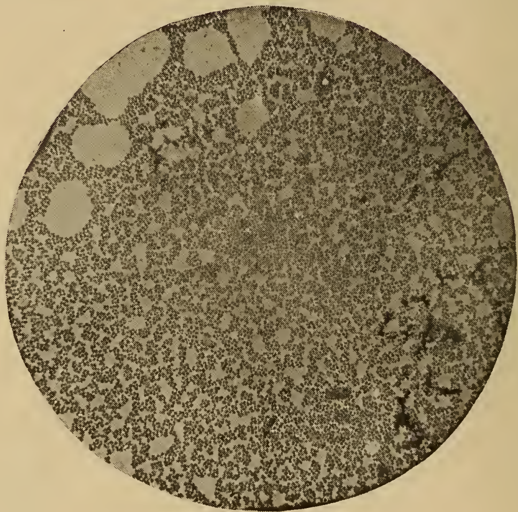
phanerogams, the potato, for instance, being propagated by subdivision of its tubers, but in due process of time blossoming and forming seed-cases. (See Fig. 2.)

The growth of micro-organisms proceeds by the decomposition of the medium in which they exist. They assimilate such of its elements as are essential to their own composition, leaving the

remainder to form various waste products, and give rise to new combinations of such of the elements of the medium as are rejected.

Under favorable circumstances, micro-organisms multiply with almost inconceivable rapidity. Cohn estimates the life-history of a single bacterium at an hour, at the end of which time it will divide into two or more. He computes that from a single individual, if all the circumstances were favorable, within five days the product might fill all the seas of the globe.

Fig. 3.



The Yeast Fungus.

The proliferation of the Torula, or Yeast-plant, may be taken as a type of the whole process. This fungus consists of single cells, produced by division of the parent cell. (See Fig. 3.) It grows in sugar solutions with the greatest rapidity, but a short time being required for the permeation of a large mass by the product of a single cell. The process of making bread illustrates this. The housewife mixes flour, which consists of starch, that is easily converted into a fermentable sugar, with a sufficiency of water; she then places the product in a warm place, after having introduced a few cells of the yeast-plant. Here are all the elements needed for development—a suitable medium, sufficient moisture, and the proper temperature.

The yeast-plant commences its growth and permeates all parts of the mixture. It decomposes the sugar, separating the oxygen, carbon, and hydrogen. It builds into itself that which is necessary and rejects the other atoms, which immediately enter into new combinations, forming as by-products, alcohol and carbon dioxide. Wherever a cell of the yeast-plant is formed, there is left as by-products a bit of alcohol and a minute globule of carbon dioxide gas. The latter distends the dough, or causes it to "rise." When this is completed it is placed in the heated oven, with the result that the yeast-plant is killed, and the dough is fixed, or cooked, and becomes bread. Beer-making is an analogous fermentation.

The alcoholic fermentation is that which results in the formation of alcohol as one of the by-products. The fermentation of grape juice, and the formation of alcohol from the starch of various grains, belong to this class. The growth of the ferment produces alcohol, which is held in solution in the water, and is then distilled off by its evaporation at a comparatively low temperature.

The acetous, or acid, fermentation is the growth of yet another organic ferment, that leaves as a by-product an acid. Of this character is the organism Mycoderma aceti, or the so-called "mother" of vinegar. It decomposes a sugar solution, and produces acetic acid as a by-product. In like manner, through the action of different organisms, are produced all of the very many true organic acids. Others of the fungi produce gelatin, and yet others various gases.

The putrefactive organisms decompose nitrogenous matter by their growth, with the evolution of offensive gases as their by-products. All the fungi grow at the expense of the medium in which they exist, and through its decomposition, or molecular change. Their by-products vary with the organisms themselves, and, as in the case of the ptomains and toxins, are sometimes of such a poisonous nature as to induce diseased or pathological conditions.

Some of the fungi grow only in the presence of air or oxygen, and hence are called "aerobic," while others flourish in tissues or cavities to which air has no access, and are called "anaerobic."

They are also said to be "obligate," those whose demand for the presence or absence of oxygen is imperative and peremptory, and "facultative," those which flourish best in one condition or the

other, though able to proliferate either as aerobic or anaerobic organisms.

The bacteria generally are self-limiting. Their own by-products are fatal to them, and when the medium in which they are growing becomes sufficiently contaminated the organisms will perish. Thus, when an acid-producing organism has made its menstruum sufficiently acid, it will die unless the acid is neutralized by an alkali, in which case it goes on proliferating, provided the pabulum, or nutritive supply, is not exhausted. All the fermentable material in a solution may be used up and decomposed, so that there will no longer be food for the organism, in which case it will die out.

One organism may destroy and supersede another by its superior activity and power of decomposition, or through its production of a chemical compound that is fatal to the first. The brewer must use the most scrupulous care to prevent the intrusion of a strange organism into his infusion, or the result may be an acid instead of an alcohol, with the consequent souring of his beer. The housewife "scalds" the pans and other utensils in which milk is kept, and submits them to strong sunlight that all infective or acid-producing organisms may be destroyed.

CHAPTER IV.

BACTERIOLOGICAL PATHOLOGY.

From the standpoint of the pathologist, the micro-organisms may be divided into several classes, according to their action upon the animal economy.

Pathogenic microbes are those whose proliferation or whose by-products cause specific pathological changes; they are disease-producing.

Saprogenic organisms are those which cause putrefaction, or the decomposition of nitrogenous matter, with the solution of ammonia and hydrogen sulphide gases.

Pyogenic micro-organisms induce suppuration, or the formation in living tissues of pus, which is the fluid produced in the process of suppuration.

Saprophytic bacteria are those which live only on dead matter; they induce decomposition and disruption of the elements of the functionless organic matter in which they proliferate.

For the study of any of these micro-organisms it is necessary to make pure cultures, obtained by implanting them, as they are mixed with others, in the best culture media, and separating out and replanting selected colonies until everything has been eliminated save that which it is desired shall be investigated. They cannot be identified by a microscopic inspection of the organisms themselves,—they are too minute for this purpose. But by observation of the phenomena of their growth, and by tests of their products, as well as by staining them with certain aniline dyes which do not affect their surroundings, they may readily be differentiated, or distinguished from other organisms.

To produce a pure culture of any organism, an incubator, or growing-chamber, is required, in which the exact amount of moisture and the proper temperature may be maintained practically unchanged for an indefinite period.

Micro-organisms penetrate everywhere that air can go. So innumerable are the different species, and so minute their size, the spores of many of them being invisible even beneath the highest powers of the microscope, that everything conceivable becomes infected with the seeds of disease and decay. A single species has in the past caused greater alarm and devastation than all the armies of the most pitiless conqueror who ever ravaged the earth. The bacillus that produces cholera has decimated nations. The various plague bacteria have invaded great cities and destroyed every second person. They have defeated and dispersed invading armies, and have stayed the march of destroying hosts. The bubonic plague, which is the result of the growth of a pathogenic organism, has, in the past, swept away one-third of the population of Europe in a single invasion.

A few of the most fatal of the maladies which are the direct result of the growth of some special organism, and which are therefore contagious in their character—the so-called zymotic diseases, of either epidemic or endemic origin—are the following: Cholera, Diphtheria, Relapsing Fevers, Leprosy, Typhoid Fever, Syphilis, Smallpox, Septicemia, Osteomyelitis, Tuberculosis, Lupus, Tetanus, Glanders, Actinomycosis, Malignant Pustule,

Gonorrhea, Leucorrhea, Scarlet Fever, Mumps, Meningitis, Erysipelas, Carbuncle, Pneumonia, Rabies, Anthrax.

Late investigations have shown that the one malady that in this country is responsible for more deaths than any other, tuberculosis or consumption, is as communicable as smallpox, and can only be acquired through infection. Its period of incubation, or development, is longer than that of most infectious diseases, but it can be as certainly stamped out by isolation, disinfection, and the use of antiseptics as can cholera, that former scourge, which in the light of our modern knowledge of bacteriology is now so readily controlled.

Were there no means of resisting the invasion and growth of the special organisms which induce these diseases, and of impeding their multiplication, they would inevitably depopulate the earth. It has already been asserted that they are self-limiting in their proliferation, through their inability to exist in the presence of their own waste products. They may also exhaust the soil or medium in which they grow, and thus circumscribe their own multiplication.

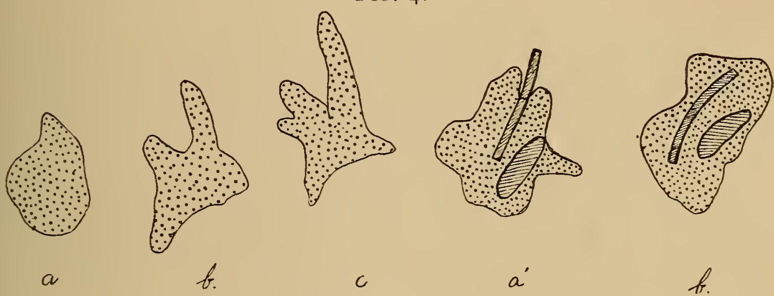
The most material factor in the prevention of the increase of the zymotic diseases is the resistive power of healthy animal function. Under ordinary circumstances, the human body successfully reacts against infection, and prevents undue proliferation of pathogenic organisms. If, however, the bodily tone is depressed through malnutrition, by unsanitary conditions, by fatigue or exhaustion, or because of functional disturbances, the resistive force of the body is so much weakened, and the conditions favorable to the growth of the disease fungi so augmented, that they multiply to an extent sufficient to bring about that pathological condition which accompanies their invasion.

Conclusive experiments upon animals have demonstrated this. Rabbits are immune to tubercular infection under ordinary conditions. Twelve of these animals were selected; six of them were kept for some time in a dank and noisome cellar, and insufficiently fed upon unwholesome food. The other six were kept in complete sanitary condition, in light and airy rooms, and were fed with the best food. At the end of a definite period each was inoculated with Bacillus tuberculosis. All of the first six took the infection and died of it; the six whose bodily tone had been preserved by

pure air and good food retained their immunity, and successfully resisted infection.

Twelve rats were selected, and six of them placed in a revolving wheel that forced them to run at a rapid gait for a considerable time. The other six were allowed to remain in a quiet place, where they would not be annoyed or irritated. When the first six had been forced to run until they were exhausted, all the twelve were inoculated with an organism from which under ordinary circumstances rats have exemption from infection. Those whose resisting powers had been reduced by extreme fatigue and exhaustion took the contagion and died, while the others were unaffected.

FIG. 4.



LEUCOCYTES.

a, *b*, *c*, Ameboid forms assumed by them, with pseudopodia. *a*', *b*', Ingestion and digestion of bacteria.

The resistive power of the human body, according to Metchnikoff, is largely, though not exclusively, inherent in the ameboid white blood corpuscles, which in a state of health envelop and digest the bacteria. (See Fig. 4.) When these are not fully formed in the system, when they are diminished in number or reduced in functional activity, the infective organisms may obtain such preponderance as to overcome all resistance, and run their course until they produce death, or become self-limiting through the formation of their own by-products and the exhaustion of the media in which they grow.

The bacteria are greatly multiplied in the presence of any putrefactive or decomposing material. Hence all decaying matter should be destroyed as far as possible, by some quicker and more

hygienic process than its decomposition by the fungi. Sanitary conditions imply the removal of all infective matter, and modern hygiene is mainly the study of how best to accomplish this. Such progress has been made within the past generation, that the average period of human life has been lengthened several years, almost entirely through the ability of sanitarians to control the multiplication of disease spores.

CHAPTER V.

SEPTIC AND ASEPTIC CONDITIONS.

The state of infection by disease-producing, or putrefactive, organisms is called a septic condition, and whatever tends to combat this is said to be antiseptic in its character. A state of freedom from all degenerative organisms is an aseptic or sterile condition, and it may be brought about by various agencies, either of a physical or medicinal nature. As moisture is one of the elements necessary to the growth of the fungi, it may be readily comprehended that its entire removal will stop all development. Hence dry climates or desiccated conditions are unfavorable to the growth of bacteria. On the elevated plains of South America beef is indefinitely preserved by drying it in the sun. In other countries the same thing is accomplished by artificial evaporation.

The proper degree of temperature is essential to growth, and the raising or lowering of this beyond a certain point will limit or prohibit it, a definite amount of heat being sufficient to destroy all organisms and render sterile any substance whatever. Upon the tops of high mountains, above the line of perpetual snow, the bacteria are almost non-existent. The cold weather of our freezing winters stops the spread of the most virulent zymotic diseases, and fermentation and putrefaction cease, except in the presence of artificial heat.

There are also certain drugs that have the ability to destroy or prevent the growth of septic organisms.

Those that are fatal to the bacteria and their spores are called Germicides.

Those that limit and prevent their growth are classed as Antiseptics.

Those that decompose or remove the by-products of infection are called Disinfectants.

Those that either mask or remove the offensive smells of putrefaction are denominated Deodorants.

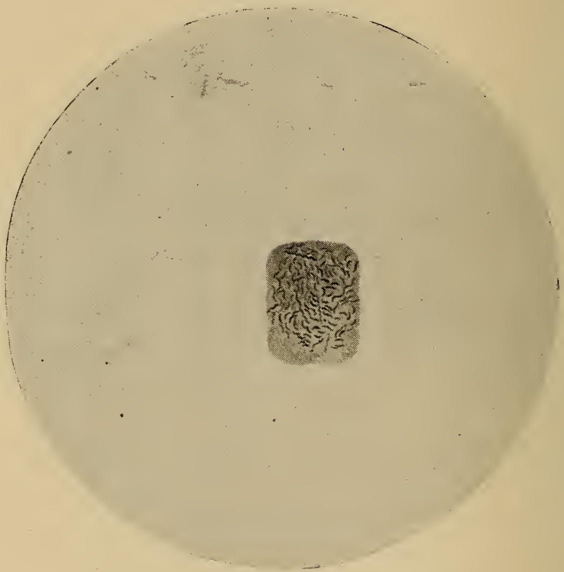
The most effective of all the agents used for sterilization is heat. The temperature of boiling water (212° F., 100° C.) is fatal to many of the septic organisms. But as the spores of some of them may successfully withstand this, it cannot in all cases be depended upon. Continuous boiling for some time will be sufficient to destroy most of the organisms contained in water. Yet, if it is to be positively sterilized, it must be distilled. If an instrument is passed through the flame of burning gas, or of an alcohol lamp, it will be made positively sterile, but this is in some cases impracticable, because it will destroy the usefulness of steel tools by drawing the temper. The tissues of the body, and of most organic matter, cannot be raised to a temperature sufficient to insure an aseptic condition, and hence we are compelled to depend upon germicides, antiseptics, and disinfectants in the treatment of septic conditions.

Most germicides are to a greater or less extent antiseptic in their nature. That is, agents that have the power to destroy germs will also prevent their growth. Many of the antiseptics are at the same time germicides and disinfectants, and *vice versâ*. In the selection of drugs for medicinal purposes it is necessary to consider something more than their germicidal or antiseptic qualities. One that is a virulent poison cannot with safety be administered internally, nor can one that is a cauterant be used on delicate tissues. It is therefore necessary to comprehend the therapeutics of antisepsis, and to select the remedy to be used in full view of these facts.

Pure germicides are not always demanded in actual practice. If a proper disinfectant is first employed to remove the products of sepsis, and to cleanse the infected tissues, it will commonly serve every purpose. Most of the disinfectants that are in general remedial use not only remove or decompose the products of infection, but are fatal to the germs themselves, and to the extent of their antiseptic influence inhibit or prevent their growth. Hence it is not ordinarily necessary to follow the use of a disinfectant like peroxide of hydrogen by a strictly germicidal or antiseptic agent.

The necessities and conditions of oral practice are such as to exclude many disinfectants, unless they are securely sealed up within the cavity of a tooth. If they are of a caustic nature, they will induce complicating lesions. If they are specially toxic, or poisonous, they may bring about serious derangements. Therefore, in their selection, the judicious practitioner will exercise great care, and choose those which, with the highest degree of effectiveness in their special action, at the same time are not injurious to

FIG. 5.



THE COMMA BACILLUS OF CHOLERA.

other tissues. In this respect carbolic, or phenic, acid, a drug that has been in most common use in oral practice, is exceedingly objectionable.

The following list of remedies, formulated by Prof. W. D. Miller from personal experimentation, and first published in the "Independent Practitioner" for June, 1884, indicates their relative antiseptic power, but is not by any means intended as a guide for choice in administration. It gives the dilutions in which each will, under favorable circumstances, limit the growth of micro-organisms:

Mercuric Iodide,	1 part in 200,000
Mercuric Bichloride,	" 100,000
Silver Nitrate,	" 50,000
Hydrogen Peroxide,	" 8,000
Tinct. Iodine,	" 6,000
Iodoform,	" 5,000
Naphthalin,	" 4,000
Salicylic Acid,	" 2,000
Oil Mustard,	" 2,000
Benzoic Acid,	" 1,500
Potassium Permanganate,	" 1,000
Oil Eucalyptus,	" 600
Carbolic Acid,	" 500
Hydrochloric Acid,	" 500
Borax,	" 350
Arsenic,	" 250
Zinc Chloride,	" 250
Lactic Acid,	" 125
Sodium Carbonate,	" 100
Listerine,	" 20
Alcohol,	" 10
Potassium Chlorate,	" 8

The disinfectants act chiefly through their ability to decompose offensive products. This is usually brought about by the presence of free oxygen, or that which is held in loose combination. Chlorinated solutions are effective through their ability to decompose water, thus setting free one or more volumes of oxygen, which is really the agent of decomposition. Hydrogen peroxide is very widely employed in oral practice, because it so readily parts with its extra volume of oxygen. Pyrozone is a more permanent and abiding preparation of nearly the same character. Electrozone, which is a decomposed solution of ordinary sea-water, is very effective, and has the advantage of being entirely innoxious. It may be swallowed, or used on the most delicate tissues, without ill effects. It is produced by an electrolytic current, which decomposes the chlorides and bromides of the salts, changing them into hypochlorites and bromites, and these are most effective disinfectants.

Deodorants are not necessarily chemical agents. They may merely be able to absorb noxious matter. An excellent one is

pulverized charcoal, which has the power to absorb a number of times its own volume of deleterious gases. It thus acts also as a disinfectant. The deodorants most commonly employed by oral practitioners are drugs of such penetrating, though pleasant, perfume that they cover and mask the odors of putrefaction, though without in any way neutralizing or decomposing them. It is needless to say they have no special therapeutic value.

Detergents are cleansing remedies which are sometimes in demand. They have no particular medicinal virtue, but remove certain superficial deposits from tissue surfaces, or from wounds, ulcers, etc. Pure water is excellent for this purpose, or a solution of borax, of common salt, or of soap may be used.

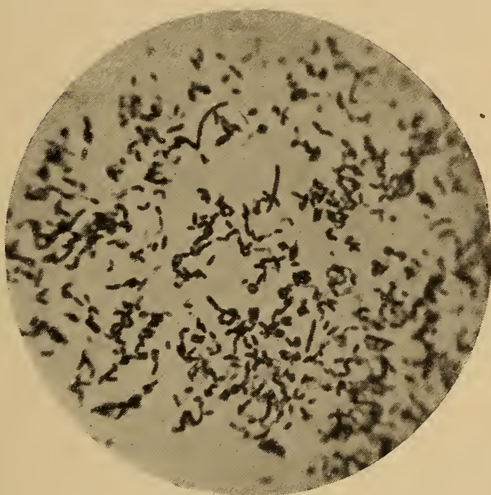
Suppuration is primarily the breaking down of the product of inflammation, and its infection by a special microbe. Whether the breaking down is due to the organism, or *vice versâ,* was long a disputed question. More recent investigations have established the fact that it is infection that brings about the devitalization of the blood corpuscles and the production of pus, and yet it has been demonstrated that it is possible for pus corpuscles to be produced without the presence of bacteria. Such a condition must, however, be unusual, and it cannot present all the characteristics of the suppuration induced by pyogenic organisms.

Ordinary pus is composed of certain nucleolar corpuscles that are indistinguishable from the white blood cells, and which are supposed to be these dead leucocytes, the extravasated serum of the blood, and such broken-down tissue cells as may exist in a certain state of degeneration. This material is found infected with certain pyogenic fungi. The formation and presence of pus is accompanied with the pyogenic fever, and its presence in the tissues may also, under favorable circumstances, be determined by fluctuation beneath the fingers. When it is formed within the tissues it makes its way to the surface by the readiest route, that of least resistance, through the process of rotting or breaking down of the obstructing tissue, and thus forms an abscess. The process of suppuration is essentially one of extrusion, or expulsion of effete or dead matter. That inoculation, or infection of healthy tissue with the suppurative bacteria, will induce the formation of pus and the production of an abscess is thoroughly established. Hence, in all curative processes it is essential to use the utmost care to avoid infection, and all the

modern methods of antiseptic surgery are built upon the ability to control the growth of septic organisms.

All of the pathogenic and pyogenic bacteria are very easily communicated, either by direct contact and contamination, or through their spores, which may be floating in infected air. Modern surgery is superior to that of a few years since in the results obtained; surgeons have learned how to avoid and guard against septic infection. It is now known, for instance, that if erysipelas once makes its appearance in the surgical ward of a

Fig. 6.



Bacillus of Diphtheria.

hospital, mere exposure to the contaminated air will be likely to induce erysipelatous inflammation in any patient, but especially those in an atonic or debilitated condition. The bacillus of diphtheria has been known to be carried by a garment that had been repeatedly washed after infection. (See Fig. 6.)

Infection may be carried upon the hands, in the clothing, or by instruments and implements. The surgeon who would now attempt even minor operations without the most strict aseptic precautions would be deemed unfit to practice his profession. His hands must be most thoroughly washed, all impurities removed from beneath the nails, and they must finally be carefully drenched with a steriliz-

ing solution, that no contaminating fungi may be carried to a wound. Every instrument used must be kept in a sterilizing solution, and sponges and lints must be heedfully rendered non-infectious. The ordinary clothing must be covered with clean linen garments, that are less liable to carry infection than woolen, and every article used must be scrupulously clean.

The dentist should always wear a clean linen coat at the chair. Any woolen overgarment must soon become thoroughly impregnated with disease germs, and thus he may carry contagion to successive patients. He himself and the most healthy and vigorous of them may be able to resist infection, but those who are weak and anemic and who do not possess the same withstanding ability may be seriously affected. Omission of these proper precautions will also be likely to result in infection and suppuration of the wounds which may be accidentally or are necessarily made, and even gangrene may be the consequence.

Every operative dentist, or oral surgeon, needs to exercise especial care in this direction. There is no mouth that does not contain some species of bacteria. Indeed, the presence of some of them seems essential to perfect health, because they exercise a distinct diastatic function, and thus in normal conditions may assist in the process of digestion. The human mouth presents all the conditions favorable to the growth of the bacteria, because the *débris* from different kinds of food, especially of starches, is always present. The diastatic action of the saliva converts these into fermentable sugars, and thus presents the best medium for the proliferation of very many of the bacteria. Moisture exists in sufficient quantity, and the temperature is exactly that best suited to their development, and it is maintained at a point as constant as could be secured in the most perfect incubator. Indeed, the human mouth is a more perfect growing-chamber for the breeding of germs than any that the ingenuity of man could possibly devise. Not only is the temperature uniform and the media and moisture at the best, but fresh pabulum is constantly added, while the by-products are promptly removed and neutralized, so that there is no limitation of growth through their formation.

The importance of every antiseptic precaution on the part of the practicing dentist cannot be overestimated. He frequently meets with pus in the oral cavity, with gangrenous pulps in teeth,

and his instruments are almost constantly infected with septic organisms. These may be deeply buried beneath the *débris* between the leaves of burs and the serrations of files, so that mere rinsing in a sterilizing fluid will not sterilize, and infection of perhaps the most loathsome character may be carried to the mouth of the next patient, unless scrupulous care is used. It is something more than a professional blunder when an operator will work in the presence of pus, or any infection, without subsequently cleaning and sterilizing in the most thorough manner every instrument employed, by means of a specially devised apparatus, and the use of disinfecting agents, such as bichloride of mercury, carbolic acid, potassium permanganate, formalin, and other solutions.

CHAPTER VI.

INFLAMMATION: ITS GENERAL CHARACTERISTICS.

A careful study of the etiology, symptomatology, and pathology of the inflammatory process is of the first importance to the student in dental medicine, because with bacteriology it forms the basis of most degenerative changes. Nor is it only concerned in retrogression. If hyperemia is accepted as one of the early stages of the inflammatory process, it is an important factor in many physiological and progressive metamorphoses as well. Wounds are healed and lesions repaired through its agency in some of its many phases; it is thus an element in the building up, as well as in the tearing down of tissue. There are emergencies in which the oral surgeon or physician desires to invoke its aid, and he sometimes deliberately incites its action. But to reach the success at which he aims he must be able to control and limit it, to impede its action here and to further its energy there, and at all times to check it before it shall reach a degenerative or infective stage. Unless the practitioner has a fair comprehension of this important process, he will always be at work in the dark, and his treatment of most diseased oral conditions will be wholly empirical and experimental. The student will not be able intelligently to investigate any of the disorders to which he hopes successfully to minister, without a careful preliminary study of inflammation.

The most advanced of modern pathologists, while they have extended the field of observation, have materially simplified the nomenclature. They recognize many added phases which the inflammatory process may assume, but in the light of the most modern bacteriological research they acknowledge but one dis-

FIG. 7.

SECTION OF A TOOTH-PULP. (Burchard, after Röse and Gysi.)

B.V, Principal bloodvessels. *C*, Capillaries. *N.T*, Principal nerve trunk. *N.F*, fibrillæ of nerves. *Od*, Odontoblasts. *S.D*, Secondary dentine. *C.G*, Masses of calco-globulin.

tinct form, that being the *infective*. Up to the point of invasion by septic organisms and the commencement of the deteriorative or destructive process, they denominate the condition one of hyperemia. Until disease germs are communicated they declare there can be no breaking down of tissue, or of the elements of tissue. There may be failure to organize the embryonal constituents, but the

disorganization of that which has once been constructed can only take place after infection. Hence, according to their views, all of the early symptoms and phenomena which are usually classed as a part of the inflammatory process belong to the distinct condition hyperemia, and are indicative only of a local plethora, or congestion.

In this conception, and according to this nomenclature, inflammation is essentially a destructive process, and its initial point is the beginning of the disorganization of tissue. This hypothesis emancipates us from the old and absurd nomenclature, under which every different phenomenon exhibited by what must necessarily be a single process was given a separate name and classed as a distinct form of inflammation. Some writers have specified as many as fifteen kinds of this process, and treated each as a separate pathological condition. There has been no identity of view, and no harmony in description or terminology. There has been no universally accepted theory which might be adopted, but each pathologist has been in one sense a law unto himself, and has instructed according to his own views.

If the most modern hypothesis shall be generally adopted, there is no doubt that it will materially simplify pathological instruction, and reduce to a comprehensible system much that has heretofore been incongruous and unintelligible. But in the preparation of a book to be used in teaching, extreme views should not precipitately be adopted. They are not likely to be in harmony with the teachings of the other departments of a school, they are in conflict with instruction already given and with preconceived ideas, and until they can be generally accepted tend to produce confusion in the mind of the student, and are prejudicial to that unity in theory and consecutiveness in thought which are essential to good tuition. It is infinitely better that the student in college should be given but one hypothesis, rather than a number of conflicting theories. When he is familiar with that, he may in practical life leave its limitations and modifications, and become acquainted with other views.

This work, then, while fully recognizing the reasonableness of the most modern theories concerning inflammation, will not fully adopt their nomenclature, but will follow the usually accepted views, modified to a certain extent by the indisputable facts established by the most modern research.

But, while making this concession, it must not be understood that it accepts or approves the infinitesimal division of that which is really indivisible, and that it will consider every accidental phase of that pathological condition which is denominated inflammation as a distinct and separate disease. There can be no essential difference between an inflammation of the pulp of a tooth, or its pericementum, and the same degenerative process in the tissue of the tongue, or the brain, or the lungs. It is true that each may assume certain definite phases, and may exhibit varying phenomena or symptoms, but these are induced by structural modifications, or by differences in the environment and surrounding conditions. The pathology is essentially identical; the same causes produce it in either case, and though we may denominate the special phenomena as exhibited pulpitis, pericementitis, glossitis, or pneumonitis, according to the location, we should not look upon them as separate, distinct, and diverse diseases. The same general treatment will be pursued in all cases; the same remedies are applicable, modified only by the modifying conditions or surroundings. Hence in the general study of inflammation we should consider it as always the same degenerative process, and carefully avoid the unnecessary multiplication of terms.

Inflammation may be defined as a disturbance of nutrition in a tissue or organ, primarily characterized by hyperemia and accompanied by certain definite symptoms. Its proximate cause is irritation of some kind, producing nervous shock, either direct or reflex, which is conveyed through the vaso-motor system to the capillaries and first manifested by changes in those vessels, thus modifying the nutritive blood current. That the student may comprehend this, it is necessary clearly to define some of the terms used, and to indicate in what sense they are employed.

Plethora is that state in which there is an abnormal fulness of the bloodvessels; a superabundance of blood; an undue increase in the entire mass of the blood in the system.

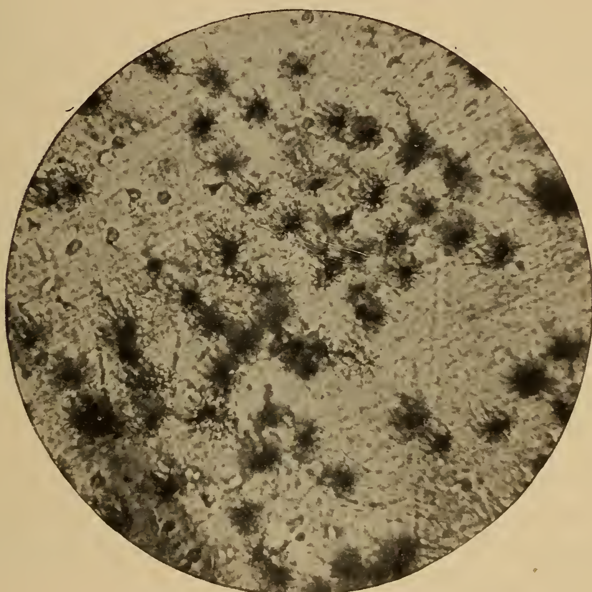
Anemia is the converse of this. It is a state in which there is a deficiency of the blood as a whole, but especially a lack of the red blood corpuscles. It is therefore a condition of depression of the tone of the system, and of enfeebled nutritive ability.

Hyperemia is a local plethora or congestion of blood. Its special seat is in the capillaries.

Ischemia is a local anemia. It implies a lack of nutrition in a part, as anemia does in the general system, because the supply of blood is for some reason insufficient.

Hyperemia implies an alteration in the velocity of the current of the blood in both veins and arteries. It also includes a variation of the bloodvessels in their character or tone, their nutritive power being modified. There is a change in the condition of the coats of the smaller arteries and veins; they assume a state either of tense-

FIG. 8.



CEMENTUM, SHOWING THE CEMENTUM CORPUSCLES, OR LACUNÆ, WITH THE CANALICULI. (Broomell.)

ness or laxity that is not normal to them. They become turgescent. The color of the blood in the veins is changed by modifications of nutrition. It is no longer of a dark or venous color, but more nearly approaches a bright arterial hue, due to its inability to perform its true function and exchange its oxygen for the carbon dioxide that is the result of the degenerations of tissue due to wear. There is a partial obstruction of the current in the arterioles, and they may even begin to pulsate with the larger arteries. Both veins and arteries become distended with the increased flow of blood. The

blood corpuscles are greatly increased in number and modified in tone.

If the irritation that has produced this condition in the tissues is not continued, the disturbance will be but temporary, and will soon subside. The system recovering from the nervous shock, the bloodvessels will soon regain their normal tone, the vascular fluid will begin to flow in its wonted manner, the congestion of the capillaries will be relieved, and the hyperemic condition will pass away.

It has already been affirmed that it is the nervous shock produced by the action of some irritant which induces the change in the condition of the arteries and veins that accompanies active hyperemia. Technically it is not the bullet in the heart that kills; it is the nervous shock caused by the irritating bullet. The knife stab may injure certain tissues that are not vital; but in so doing it may produce a nervous impression that is so profound as materially to interfere with the processes of life which are vital, function may cease, and that is death. It was not the wound that killed, but the markedly depressing influence which it induced upon organs themselves untouched. It is necessary to keep this distinction carefully in mind in the consideration of inflammation.

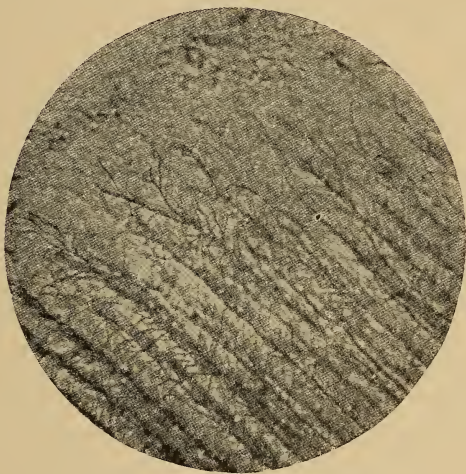
Shock may be produced by either direct or reflex nervous action, and it may be immediate or delayed.

By direct, we mean the irritation that is produced by actual injury to the terminal nervous filaments themselves. Thus a blow upon the cheek will induce a redness, or hyperemia in the capillaries of the tissue that received the irritation, and whose nerve filaments were really harmed or shocked by the impact.

By reflex nervous action, we mean that in which the impulse is reflected, or carried by one set of nerves to another set, thus producing its effect at a distance from the seat of irritation. The influence of an irritant may be carried by an afferent, or sensory nerve, to some great center, where it will be transmitted to an efferent, or motor nerve, and the stimulus carried along its course until it reaches the tissue supplied by it, and it may be upon this that the characteristic effect will be indicated. Or the effect of the irritating agent may be received by one afferent nerve and reflected to another of the same system, the subjective sensation, with the local effects, thus being made manifest at some distance from the point of injury.

The blush that is brought to the cheek of the sensitive young maiden by an indelicate remark is the same kind of transient hyperemia that is produced by a blow of the hand. Yet in the former case there is no real impact, no positive injury, no actual lesion of any kind. But the hyperemia will probably be more pronounced and marked than when the nervous action is direct. The face will blanch under the influence of fear, when no direct impact could produce this effect. The hair will stand erect through reflex action caused by intense alarm or terror, a state that no voluntary action could

FIG. 9.



STRUCTURE OF DENTINE, SHOWING THE BRANCHING OF THE DENTINAL TUBULI.

bring about. People sometimes drop dead at the communication of profoundly affecting news, which acts in a reflex manner. Indeed, instant functional cessation and death are more complete and frequent in cases of shock from reflex than from direct injuries. The influence of external and surrounding impressions upon sick people will not infrequently completely neutralize the effect of medicinal agents.

Profound anesthesia cannot readily be obtained in people with unusually responsive nerves, unless external irritation and interference is cut off. It becomes necessary in such instances to remove all exciting causes and establish complete quietness about them.

It would appear, then, that of the sources of irritation that may produce hyperemic conditions, those that are derived through reflex nervous action are the more important, and should be most carefully guarded against.

CHAPTER VII.

CHANGES ATTENDING THE INFLAMMATORY CONDITION.

The changes in the veins and arteries that induce a condition of hyperemia are produced through the vaso-motor nerves. These are derived both from the cerebro-spinal and the great sympathetic systems. They are the non-medullated terminal filaments whose special function it is to govern and keep in proper relation the coats of the bloodvessels to which they are distributed. Upon the larger vessels they form intricate plexuses, sending out single filaments, or bundles of filaments, which twine about the vessels, penetrate their external coats, and are principally distributed to the muscular tissue of the vessel, and by their action in contracting or relaxing the artery or vein they govern the amount of the blood-flow.

There are presumably two kinds of nerves in the vaso-motor system, one being the constrictors and the other the dilators. It will readily be seen, then, that either may be excited and the caliber of the vessel modified accordingly. Nor is the amount of blood necessarily and completely gauged by the question as to whether it is the dilators or the constrictors that are excited to action. There may be a lessening of the caliber but a retention of the elasticity of the muscular fibers that will result in a great increase of the velocity, and this may have a tendency to wash away any obstructions in the blood channels. On the other hand, there may be a dilatation with a loss of tone and a complete rigidity of the muscular coats that will eventuate in a reduction of the velocity as well as in the amount of blood conveyed.

There may be a contraction of the vessel, with a condition of such tonicity as will greatly augment the velocity of the circulatory fluid, or there may be almost a complete stagnation of blood in a greatly relaxed artery or vein. Niagara river at its head is

nearly two miles wide. At the Whirlpool rapids below the Falls it is contracted into a narrow channel but a very few hundred yards across. Yet a somewhat larger amount of water pours through the gorge of Niagara than flows past Buffalo. Lake Ontario is but a great expansion of Niagara river, augmented by tributary streams. At Buffalo the Niagara is a smooth and steadily flowing current which subserves a thousand useful purposes. The Whirlpool rapids is a tumultuous, riotous torrent, suggestive only of death and destruction. Lake Ontario is a sluggish, lethargic expanse, almost without current. Under the influence of the vaso-motor nerves, and according to their tonicity or lack of it, the blood current in the capillaries may be a steadily moving, gentle, nutritive current, a violent, turbulent, destructive torrent, or a phlegmatic, stagnant expansion.

It may readily be seen, then, that the tone of the walls of the vessels has very much to do with the blood supply. Through the reaction of the vaso-motor nerves, the very character of the coats of the capillaries may be materially modified, so that instead of retaining their contents they allow an undue emission through the meshes. The different coats may become so relaxed that through their walls the red or the white blood corpuscles, or the serum of the blood, may readily exude, and so pass out into the surrounding tissues, infiltrating them and producing certain symptoms which attend the condition that is commonly called the inflammatory state. All these changes must be massed in the consideration of the inflammatory process.

The first stage is hyperemia, or an increased blood supply, through modification of the caliber of the coats of the bloodvessels.

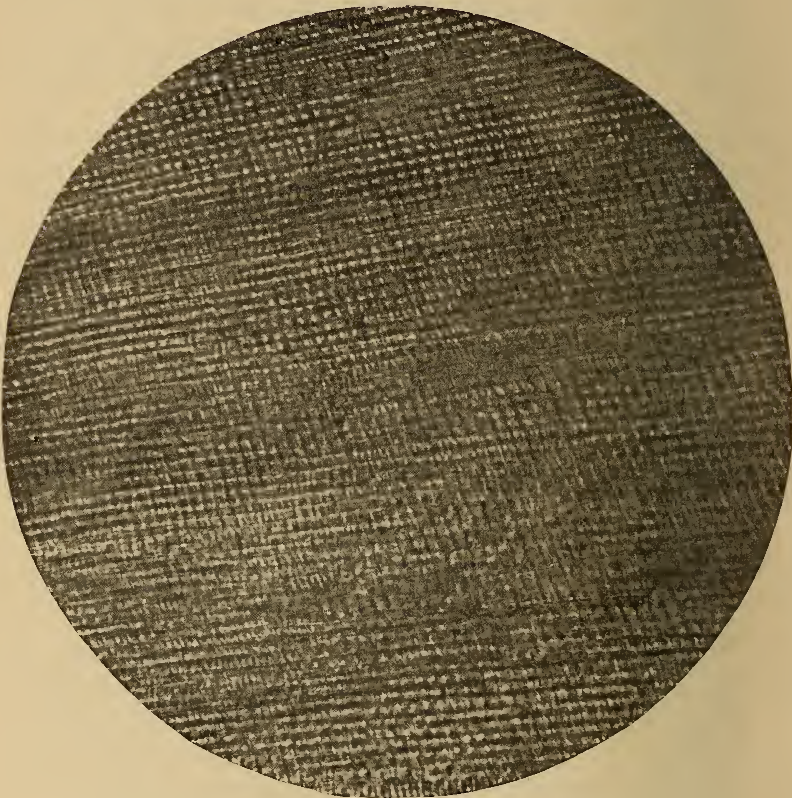
The second stage consists in the further changes in the condition of the coats of the vessels, by which they become so modified as no longer perfectly to retain all their contents.

The third stage is the modification produced in the tissues through the extruded contents of the bloodvessels, for the elements having once passed out cannot enter them again, but must be otherwise disposed of. This stage necessarily includes the degenerative processes taking place in the products of inflammation which result from infection.

It should be apprehended that the mere change in the caliber of the vessel forms no necessary part of the inflammation, which

may terminate with the simple hyperemia. But the second change, that in the vessels, which so modifies them that they no longer retain their contents, produces a more profound impression and materially affects the tissues nourished by them. When the extravasated matter becomes infected with pathogenic or pyogenic

FIG. 10.



ENAMEL HIGHLY MAGNIFIED, SHOWING THE CHARACTERISTIC PRISMS. (J. L. Williams.)

micro-organisms that impression is intensified, and degenerative processes are set up. This is an active state of inflammation, in which all the nutritive processes of the part are engaged.

There are certain symptoms that are peculiar to inflammation and which always attend it in a greater or less degree. They are heat, redness, swelling, pain, and usually a general febrile condition.

The violence of these will depend upon the gravity of the disturbance and the character of the tissue affected. Other things being equal, the more vascular it is, the greater the blood supply, the more pronounced will be the symptoms.

The first of these, heat, is due to a number of factors. The deeper portions of the body have a higher temperature than those that are superficial and are exposed to external cooling influences. When the blood quickly reaches the periphery it will lose less of its vital heat than when it makes its way more gradually. Hence, in the increased velocity of inflammation, the surface has more of the heat of the internal portions of the body.

Again, this very velocity generates a certain amount of heat by the increased friction. There is also some increased oxidation, and this adds to the higher temperature. All of these factors together account for the increased local heat of inflammation.

The redness is due to the hyperemic condition, the increased amount of blood in the part, and the unchanged color of the venous circulation. The intensity of the change will depend upon several factors. The amount of the local disturbance, the thickness of the superimposed tissues and their degree of translucency, will all have an influence. Persons with thin, transparent skins show the superficial hyperemic condition much more plainly than others.

The swelling is the effect of the diapedesis, or escape of the elements of the blood through the walls of the vessels, because of their changed condition under the irritation manifested through the vaso-motor nerves. The tissues are thus infiltrated and distended. The amount of this dilatation or expansion will depend upon the nature of the tissue in which it takes place, and upon the character of the functional disturbance.

The pain is the effect produced upon the terminal nervous filaments by the deranged condition, and the pressure of the exudate. Sometimes this will be of a throbbing character, due to the pressure exerted by the arterioles at each heart contraction, or systole, upon the already irritated and sensitive terminal nerve filaments. Boring pains are usually connected with inflammations of bone tissue. Lancinating pains ordinarily accompany acute swellings, and are indicative of a determining abscess. Soreness is due to the formation of an abscess cavity in a very sensitive tissue or organ. That of a boil, which is an instance of suppurative inflammation, is proverbial.

The general fever is the result of the sympathy of other organs with that which is directly affected. It is the office of the nervous system to preserve the equilibrium of the various functions of the body. When this is disturbed by an aberration existing in any organ, all the others suffer to a greater or less degree, and thus is produced a general feeling of malaise or discomfort.

The causes which excite an inflammatory condition are divided into predisposing and exciting.

Predisposing causes are special conditions of the body which render the organs or tissues more liable to take on the pathological conditions. In the presence of predisposing causes, comparatively slight irritation may result in serious disturbances. A state of atony, or asthenia, or general debility, reduces the resistive force of the tissues and promotes the invasion of disease. Anemia is another predisposing cause, the poverty of the blood, or the lack of certain of its elements, seriously interfering with that nutrition which must maintain the general tone.

The exciting causes of inflammation are very many, and include whatever may produce shock, such as cold, heat, traumatism or injuries, etc. A common cold is an inflammation induced by subjecting one part of the body to a sudden diminution of its temperature, and thus disturbing the general nervous equilibrium or tone. Many chemical substances are nervous irritants, either through direct or reflex action. Poisons act in this way, and these include the stings of bees, the bites of many insects, and the peculiar effect of certain vegetables, such as poison ivy and oak.

Many of the pathogenic micro-organisms induce a state of inflammation through their growth in the system. All lesions, wounds, and injuries give a shock that is more or less profound, and thus bring about inflammatory conditions.

A cachectic state, or dyscrasia, is one either of disturbed general nutrition or of local degeneration, that makes the organs liable to inflammation, as in gout, calculus, etc.

It has already been affirmed that a nervous shock that affects the vaso-motor system may so change the condition of the blood-vessels as to permit the escape of a portion of their contents. John Hunter recognized the intimate connection of the blood current with inflammatory processes, and declared that hyperemia and congestion were their initiative stages. Less than thirty years ago,

Cohnheim published the results of a series of observations that gave the world a new insight into the pathological changes that accompany this disturbed condition, especially in the earlier modifications. Other pathologists have carried the explorations further, and some of them have dissented from a part of the conclusions of Cohnheim, but his general deductions are accepted as correct by most pathologists.

CHAPTER VIII.

FURTHER DEGENERATIVE CHANGES.

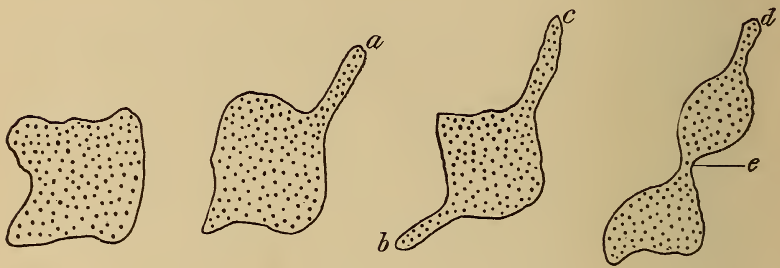
If the mesentery of a frog is exposed to the air and placed under a microscope, it will be seen that the flow of blood in the capillaries is greatly augmented. They are distended, and many that had been invisible are by this dilatation brought into view. The leucocytes, or white blood corpuscles, are gradually increased in number. Regions in which there normally appears only an occasional one, soon become thronged with them. The increased velocity of the current lasts but a short time, when the flow begins to be retarded, and is soon slower than the normal, the distention still remaining. A partial stagnation succeeds, and the white corpuscles begin to accumulate in the small veins and arteries, and show a tendency to cling to the walls. They are swept back into the lessening current, but soon find another point of attraction, and finally remain attached to the lining surface. They soon become so enormously increased that the inner surface of the vessels is completely covered with them. In the capillaries and arteries the white corpuscles are mingled with the red, and do not accumulate in such great numbers, but in small veins they seem to have become separated from the red and to cling in greater numbers.

Soon they begin to alter their appearance, and to exercise their peculiar ameboid, or spontaneous change-of-form movements. (See Fig. 11.) The vessel wall remaining distended, after a little time there is observed upon its external surface a minute protuberance, which momentarily increases, the cell opposite upon the internal wall correspondingly diminishing, until it is seen that the whole of the jelly-like protoplasmic leucocyte has penetrated the

walls and been extruded upon the periphery. Coincidental with the changed condition of the vessel walls, other of the contents have passed through and invaded the surrounding tissues. The leucocytes have been considered as the active agents of repair, themselves forming the initial or germinating point in the organization of the plastic exudate into tissue. This hypothesis seems most consistent with known facts, and offers a ready explanation of some phenomena not otherwise comprehensible.

It is but proper to say that this theory is not accepted by some histologists and embryologists, who consider the leucocytes but as scavengers for the removal of offensive matter.

Fig. 11.



Leucocytes, showing Ameboid Movements.
a, *b*, *c*, *d*, Pseudopodia. *e*, Constriction when passing through the coats of a bloodvessel. (Very much enlarged.)

That the leucocytes have a digestive power, appropriating bacteria, has been shown by a number of observers. They may also be useful in consuming portions of broken-down tissue, and hence assist in the absorption of blood-clots, exudations, etc. But that this is their sole office does not seem congruous or compatible with demonstrated truths, and it is not accepted in this connection.

The number of leucocytes is notably increased during inflammation. They may be seen to gather in great numbers in the smaller vessels, and they migrate in profusion into the surrounding tissues. Their origin is yet in dispute. It was formerly held that their multiplication was due to increased cell proliferation or formation under the stimulus of the inflammatory process. But Von Recklinghausen found in connective tissue two kinds of cells, which he called the fixed and the wandering. The former he says are stationary among the fibers of the intercellular substance, and

are round, or spindle-shaped. In addition to these he observed other cells, in all respects resembling the leucocytes, which take on spontaneous changes of shape by means of the extension of a portion of their jelly-like substance (pseudopodia—false feet), such as are characteristic of the ameba, and hence called ameboid movements. By means of these mutations they constantly changed their location, passing through the meshes of the lymph canals, entering from the blood and escaping through the lymphatics, thus keeping up a constant circulation. In normal tissues they were few in number, but in the presence of irritation or inflammation they were inordinately multiplied.

This is the generally accepted theory of to-day. The wandering cells of Von Recklinghausen, or the white blood corpuscles, or leucocytes, which even in entire health are escaping through the walls of the bloodvessels in small numbers, by means of their ameboid movements may traverse the tissues through the lymph channels until they are finally extruded. Their probable generation is in the lymph glands or nodes, the spleen, etc., and in inflammatory conditions they are enormously increased, and are carried by the blood to the disturbed territory, whence they readily pass into the tissues through the changed condition of the vessel walls. Their multiplication in an inflamed tissue is in proportion to the violence of the disturbance.

Corresponding to this increase in the number of the white blood corpuscles in the tissues is the extravasation from the bloodvessels of the fluid portions, or the blood plasma. The fibrinogen which this contains, coming in contact with the paraglobulin and ferment of the leucocytes under their changed condition, fibrin is formed and the lymph is coagulated or fixed in the tissues. The product thus formed, with the emigrated blood cells, composes that which is known as the "plastic exudate" (plastic or organizable lymph, fibrinous lymph), and it is the progressive or degenerative changes in this substance that constitute the further phenomena of inflammation.

The plastic exudate once having been formed in the tissues, it may assume such a complete fibrination, such an entire conversion into a dense compact fibrin, as to produce that which is called an induration. This at times assumes to the fingers almost the hardness of bone. In inflammation of the tissues about the jaws it is

not infrequently mistaken by the novice for bone, and a wrong diagnosis is accordingly made. It may be immovable, without special sensation or pain, and apparently closely attached to the osseous tissue. In this form the plastic exudate is persistent and indolent in its character, and does not readily degenerate nor assume a progressive aspect. It may disappear under the slow process of gradual resorption, or it may eventually break down.

CHAPTER IX.

THE PRODUCTS OF INFLAMMATION.

The methods by which the plastic exudate, or the coagulable or fibrous lymph, and the remaining products of inflammatory conditions may be disposed of, are by (1) Resolution, (2) Building up, (3) Tearing down.

Resolution means the taking up of the products by the absorbents, and their disposition through the lymphatic system. There is a cessation of irritation, the bloodvessels return to their normal condition, exudation ceases, and there is a gradual return to a true physiological state, as there is when hyperemia alone exists and the disturbance does not extend to the point of active inflammation.

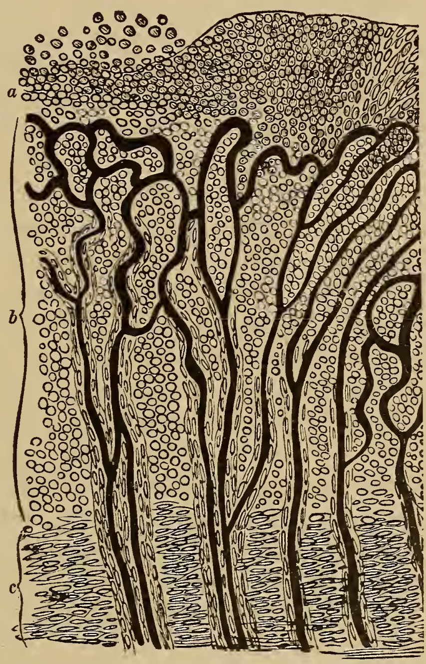
Building up of tissue means that the plastic exudate has been by regular progressive changes organized into tissue of an embryonic character. The methods of this metamorphosis are by first, second, and third intention.

First Intention.—*This implies a regular progression from the commencement, without any degenerative changes whatever. No pus is formed, nor is there infection by micro-organisms.* The term "healing by first intention" is usually applied to wounds, either traumatic or surgical, especially to those of an incised character. If the gaping produced by the elasticity of the tissues is closed, and the severed parts brought into nice coaptation, either by stitches, adhesive plaster, or finger manipulation, the fibrin that is formed by the plastic exudate agglutinates or cements them together, and union without any violent or disruptive inflammation may ensue. This can only be secured by thoroughly

aseptic conditions, and it is this at which all surgeons aim in their treatment after operations.

Granulation, or Second Intention.—*This is the building up of the tissue, or the organization of the exudate by means of papillæ, or grain-like growths, that spring up from the base of healing wounds.* It is a progression cell by cell, instead of organization

Fig. 12.



Granulating Tissue, showing the Capillary Loops. (After Rindfleisch.)
a, Dead leucocytes. *b*, Granulating tissue. *c*, Commencing metamorphosis of granulations into a fibrous structure.

more in mass. Capillary loops are formed in the extravasated plasma, which as it is poured out will be found shielded by a kind of transparent glistening film, that protects it until the lost tissue has been restored and the skin shall have been formed over it. This new growth is known as granulation tissue, and is always of a cicatricial or elementary character. The new formation is primarily of the connective tissue variety, and is subsequently modified into that of which it forms a part. (See Fig. 12.)

The organization of the tissue, when it proceeds without any degenerative processes, may be clinically studied in the socket from which a tooth has been extracted. The cavity will at first be found filled with coagulated blood, which effectually seals the mouths of the ruptured vessels. Within a very few days at the most, this will have been sloughed away or materially modified, and the socket of the root will be found occupied by a kind of translucent, jelly-like substance, which is very easily wiped away with a pledget of cotton. If it is left undisturbed a short time longer, it assumes a firmer consistence and becomes opaque and of a whitish color. This is the plastic exudate that has been effused. It now cuts like gelatin, and has the same general appearance. Another day, and if it be divided with an excavator or the point of a sharp bistoury, a minute drop of blood will ooze out. This indicates the formation of blood channels within the mass. There is no continuance of blood flow, for circulation has not yet been established, but minute sinuses have been formed, and they are filled with sanguinary fluid. In yet another day or two these will have become connected with the blood channels of the surrounding tissues, and a form of circulation will have been established. The exudate is now firmer, and cuts like new, partially formed cartilaginous tissue. The mucous membrane and epithelia form over it, and it assumes the appearance of the surrounding gums. Then commences the process of calcification, and soon the knife feels the grating of formative bone. Calcification proceeds until the cavity is completely filled with well-organized bone tissue. This peculiar form of healing by first intention will not be observed except in cavities that are well protected from external violence.

If this kind of formative tissue in its early periods of development is examined under a microscope, it will be found filled with small round cells, which gradually assume a spindle form, and the deepest layer will be found composed of bundles of them. This is a part of the process of the formation of embryonal tissue, which gradually is developed into that of a more perfect type. The cicatrix is connective tissue that has contracted in the course of its formation, and which thus tends to draw together the edges of a wound, but which may be so excessive as seriously to interfere with function, as is the case in extensive burns. The surgeon accomplishes this coaptation of the borders of wounds by means of sutures.

Third Intention.—*This is the term applied to the process of healing when two granulating superficies come or are brought into coaptation.* It does not essentially differ from second intention, which, indeed, must be precedent to the union of the granulating surfaces.

When by means of a continuance of the irritation the inflammatory process is exacerbated, or when new sources of irritation are introduced and infection succeeds, the healing process is interfered with, and the plastic exudate, instead of being organized into tissue, loses its integrity and is broken down, involving the investing tissue. This may be by (1) Suppuration, (2) Gangrene, (3) Necrosis.

Suppuration, or the formation of pus, is molecular degeneration through septic infection. The exudate, from continued irritation or from a lack of nutrition, loses its organizing power, becomes infected by pyogenic micro-organisms, degenerates, and forms pus. The leucocytes, or white blood corpuscles that have migrated to the inflamed territory, die and become the characteristic pus corpuscle. The plasma melts down and is mingled with the extravasated serum of the blood. The tissue in the immediate neighborhood is infected, degenerates and breaks down, and a pus cavity is thus formed.

Pus, then, is composed of *(a)* **the pus corpuscles or dead leucocytes,** *(b)* **the melted down plasma and exuded serum from the blood, and** *(c)* **the necrotic or decomposed tissue into which it has been infiltrated. It is essentially a foreign substance, and Nature puts forth her utmost efforts to expel it from the system.** The pressure is considerable, and the tissue in the line of least resistance yields and becomes disorganized and decomposed, thus extending the pus cavity, usually toward the periphery, or some natural cavity of the body. This continues until it is discharged upon the surface and an abscess is formed. The determination of this destructive process toward the place of exit is called the "pointing" of the abscess.

If the irritation has now ceased, as in the case of the extrusion or removal of some foreign substance that was in the tissues, the process of healing commences, and may proceed by granulation until the lesion has been completely restored. If the irritant

is not carried away by the first suppuration the process will be repeated. In a discharging alveolar abscess arising from irritation and infection of the pericementum of a dead tooth, the plastic exudate will be effused about the point of irritation, only to be infected in its turn, and to break down with new formation of pus. At first these pointings will be periodical. They may be precipitated by any general inflammatory condition, and follow upon the so-called taking of a cold. After a time the condition becomes chronic. There is a steady effusion of the exudate, and it is as regularly infected and broken down, and thus an almost continuous discharge of pus from the sinus formed is the result.

Pus was formerly classed as laudable or healthy, serous, sanious, ichorous, etc. We now know that the thick, creamy, opaque, yellowish discharge, which was formerly denominated laudable pus, is the uncontaminated, undecomposed discharge from a healthy granulating surface, or from one in the process of normal healing.

Ichorous pus is the thin and acrid ejection from an ulcerative surface, or is that which has passed through a second degenerative process. It may be excoriating and cause an abrasion of the surrounding tissues if they are not protected from its influence.

Sanious pus is that which is mixed with blood, and which partakes of the nature of both. It is usually an indication of a destructive action, and of the cellular sloughing that accompanies the breaking down of tissue. It may be ichorous in its character.

Serous pus is that which is mixed with serum from the blood. It differs from sanious pus, in that it is more simple in its nature, and is not indicative of secondary putrefactive changes.

Muco-pus is that which is mixed with the secretions of the mucous glands. This is probably but an accidental complication, and the character of the pus is not thereby materially changed. It does not imply that there has been any secondary infection with destructive organisms, or any putrefactive degenerations.

Gangrene is also known as mortification, and when sloughing takes place, as sphacelus. It is the cessation of all nutrition in a territory more or less considerable and circumscribed, with a consequent loss of function and death in mass. Its origin may be in a traumatism or wound, in a local cause like thrombus or embolism, in continued pressure either external or internal, in the too free

use of certain drugs, such as ergot, phosphorus, mercury, or carbolic acid, and finally in constitutional causes, such as diabetes or anemia. It is usually divided into moist and dry, or senile, gangrene. When the degenerative changes which succeed loss of nutrition in a part have commenced, there may be an infection with certain bacteria of decomposition, and the whole territory become highly septic. The tissue is in a putrefactive state, and auto- or self-inoculation in other tissues may be the result. This is common, or moist gangrene.

In addition to these septic conditions of gangrenous degenerations, the disease may be the direct result of infection. There are special types, due to the activity of micro-organisms, that have long been distinguished as phlegmonous erysipelas, malignant edema, hospital gangrene, noma, etc. Hospital gangrene is now almost unknown, its disappearance as a separate affection being due to our increased knowledge of septic conditions, and to antiseptic precautions and treatment.

Dry or senile gangrene presents a marked difference in its objective appearance to that of the moist type. As its name indicates, it occurs usually in old people, being seldom found in those under fifty years of age. It is usually caused by arterial disease or degeneration, through which the circulation in a part is cut off. The tissue being deprived of blood, the moisture is lost by evaporation, and there is a consequent shrinking and wrinkling of the tissues, which produces that peculiar appearance called mummification. If from the outset putrefaction is prevented, the type of gangrene is always dry.

This affection may usually be readily diagnosed. The peculiar appearance of the tissues, with the odor of putrefaction, in moist gangrene, and the coldness, dryness, and pallor of dry gangrene, seldom leave the surgeon in doubt as to the nature of the affection.

Necrosis, which in its general signification means the death of a part, may be properly used to include gangrene. In its surgical employment the term is now restricted to death of the hard or bony tissue. It is the analogue of gangrene in soft tissues, and it has the same general etiological origin. It is the stoppage of the nutritive currents, with the consequent death of the part. From the nature of the tissue in which it exists, its progress is nat-

urally slower than is that of gangrene, but the tendency is the same, and it should end in the sloughing away of the dead part from the living. When such a necrosed portion of a bone is thus separated, it is called the sequestrum, while the result of a successful effort of nature to build up new bone in its place is called the involucrum. Of all the bones of the body the inferior maxillary is most apt to take upon itself necrosed conditions. This is partly because it is more subject to accidents than most bones, but chiefly because from its peculiar connection with the rest of the body, its great mobility and the constant and violent uses which it is made to subserve, nutrition is the more readily interfered with. About three cases of necrosis of the lower jaw occur to one of the upper.

It will be seen, from a retrospective view of the preceding statements of the condition called inflammation, that it is, as was affirmed at the outset, the initial point of very many changes in the body, of a physiological as well as of a pathological nature. It commences with simple hyperemia, and ends with the final disposal of the plastic exudate by either progressive or retrogressive metamorphosis. It is the result of an irritant, which produces a more or less profound impression upon the tissues through the nervous shock. The vaso-motor system is thereby so disturbed as to modify the conditions of the bloodvessels in the neighborhood of any lesion, and to permit the passage into the tissues of their contents, through diapedesis. This extravasated matter is the plastic exudate that is either organized or disorganized, and it is the result of the earlier stages of the inflammatory process.

The termination of inflammation, then, is either in the building up of the plastic exudate into new tissue, by first intention or by granulation, or in its degeneration and tearing down by suppuration, gangrene, or necrosis. The final result depends upon the degree of the lesion or injury, upon external sanitary or unsanitary surroundings, upon constitutional tonic or atonic conditions, and upon the ability to maintain the circulation practically unimpaired.

CHAPTER X.

GENERAL TREATMENT OF INFLAMMATION.

The treatment of inflammatory states will necessarily be largely general in its character. The various remedies to be employed may be classified as follows:

For the heat—Reduce the temperature by refrigerants.
For the swelling—Use compression: apply bandages.
For the hyperemia—Use depletion: leeches, cupping, etc.
To produce metastasis—Counter-irritants, blisters, etc.
To relieve circulation—Cathartics, diaphoretics, diuretics.
To equalize the circulation—Hot pediluvia (foot-baths).
For the fever—Febrifuges, antiphlogistics.
For the pain—Sedatives, anodynes, local anesthetics.
To promote suppuration—Warmth, moisture, poultices.

The first remedial measure to be employed will of course be the removal of the cause of the irritation, provided this can be definitely ascertained. The next will be to give rest to the parts. The latter is best secured by immobility and entire repose. All use of the affected organ should cease, and it should be placed in the easiest position possible. Saline cathartics may be administered, with the view of relieving the tension of the bloodvessels by a depletion of their watery contents. Diuretics are useful for the same reason. If a laxative only is desired, Seidlitz powders may be prescribed, or mild doses of castor oil. For a saline cathartic, Epsom or Rochelle salts (magnesium sulphate, sodium tartrate), or cream of tartar (potassium bitartrate), may be employed. But still more efficacious are diaphoretic remedies, because they not only remove the water of the blood and tissues but act as refrigerants, through evaporation from the surface. They also tend to depuration by opening the pores of that great eliminative organ, the skin. Dover's powder, or some form of alcohol, with warmth and diluent drinks, may be used. In general forms of inflammation, febrifuges, such as potassium chlorate, quinine, antipyrine, and antifebrine, should be administered, and the general hygiene should be carefully looked to. If there is general irritation, sedatives, either arterial or nervous, as may be indicated, should be given.

If the inflammation shall have proceeded to the point of effusion of its products, early efforts are usually directed toward bringing about resolution, or absorption of the lymph.

Local cupping or bleeding may be useful, although the best means for securing local depletion will usually be by the application of leeches. These agents, which have of late been almost entirely abandoned, will often prove of greatest efficacy. In addition to the general remedies recommended, counter-irritants may be employed. These induce a change in the location of the inflammation by metastasis, or the production of a new point of irritation, with the consequent transference of the seat of diseased action.

Park recommends, in forms of phlegmonous infiltration, the application of an ointment composed of resorcin 5, ichthyol 10, mercurial ointment 3, and lanolin 50 parts, as a sorbefacient and antiseptic preparation. This in connection with moist heat may even secure the actual resorption of pus.

If there is local swelling, it may sometimes be controlled by bandaging, which prevents further effusion and promotes the absorption of that which has already taken place. It is not, however, usually convenient to apply a bandage or exert much pressure upon any of the oral tissues.

If there is considerable local heat, it may be controlled by the application of ice, or by the ether or alcoholic spray.

If neither resolution nor building up of tissue seems possible or probable, efforts should be directed toward the promotion of suppuration, thus relieving the tissues of the products of the inflammatory process. It is here that the oral physician or surgeon will have an opportunity for the exercise of his best judgment, and all his experience will be needed in making his prognosis, to determine the exact point at which the treatment should be changed. To ascertain when the degenerative process has begun requires the nicest perception and discernment. In inflammation of the dental pulp, for instance, to know when it is no longer wise to attempt to preserve its vitality, and when devitalization and extirpation are advisable in view of positive degenerative changes that are imminent, requires a thorough knowledge, not only of the whole inflammatory process, but of the symptomatography of all the lesions and complications as well.

The breaking down of tissue having already commenced, or being plainly inevitable, suppuration should be hastened, that the more destructive processes of gangrene and necrosis may not supersede it. Poultices should at once be employed in the direction in which it is desired that the abscess shall break. This promotes suppuration by extending such favorable conditions as are afforded by a maintenance of the temperature, the continued presence of moisture for the softening of the tissues, and the dilatation of the vessels. Any poultice that will secure this will suffice, although if it is of a fermentative substance, that process will assist in the weakening of the superincumbent tissues.

It is not convenient to use for oral application the poultices commonly employed in general medicine. A freshly cut fig or a split raisin may often be applied when no other can, and they act very effectually. They should usually be softened and warmed by dipping in hot water. They are pleasant to use in the mouth, and when one piece becomes too much softened another is readily substituted. They will usually be held in place by the facial muscles.

There are certain general remedies that promote suppuration under definite conditions, but they are little adapted to oral practice. In the treatment of inflammation the aim should always be, after diapedesis has taken place, to relieve the tissues of the exudate material, and to promote healing when there has been any traumatic wound or lesion.

Whenever pus is present it must be promptly evacuated. It is always irritative, always degenerative in its influence. There is no precept in practice that is so imperative as the one which instructs the practitioner at once to get rid of pus. There is no surgical risk that one is not justified in taking if this product can be eliminated in no other way. Sometimes a mere puncture will evacuate it, at other times a serious operation is demanded; but, whether simple or complicated the means of elimination, it must not be permitted to remain. Some judgment may be required in securing perfect drainage if an opening is made, and this demands that the artificial sinus shall be at the lowest, most dependent point when the body is in its natural position. Drainage tubes may be demanded; or gauze, catgut strands, or other media may be used to keep the opening patulous. These may be retained in position by strips of adhesive plaster.

After evacuation the pus cavity should be cleansed and disinfected with hydrogen dioxide, pyrozone, or some other effective antiseptic or disinfectant solution. The utmost care should afterward be exerted to keep the cavity clean and aseptic, if proper healing after the discharge of the broken-down infiltrate is to be secured.

CHAPTER XI.

DISEASES OF THE GUMS.

The gums are largely made up of fibrous tissue covered by mucous membrane. In their normal condition they are of a delicate pink color, and are dense and hard. They invest the teeth closely, and are adherent at their cervical portion. They are not especially sensitive, and in the absence of the teeth most kinds of food may be crushed upon them without great discomfort. Any departure from this general appearance or state is a pathological condition that demands attention from the dentist or oral physician. Local irritations, inflammations and hypertrophies, or hyperplastic conditions of the gum tissues are, however, too seldom recognized, or if noticed are not accorded proper treatment. That which should form a considerable proportion of the practice of every dentist is sadly neglected.

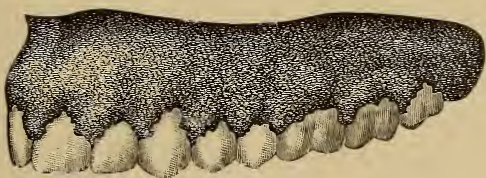
Especially has this been the case in the past. Formerly the college terms were so short that it was absolutely impossible to give adequate instruction in very many pathological conditions. Of late the curriculum has been materially broadened, and students have impressed upon them the overwhelming importance of prophylactic treatment and the early employment of remedial measures for the cure of oral disorders, before they shall have wrought irreparable mischief.

Inflamed, irritable, turgid gingivæ, loosened from their attachment to the teeth so that the point of an explorer can penetrate some distance beneath their free margins without resistance, with degenerated, atonic, congested bloodvessels that discharge their contents at the least irritation, are even now so common as to excite little comment, and the patient is dismissed without the

proper professional advice or remedial attention. (See Fig. 13.) These same unfaithful practitioners perhaps bewail the multiplication of dentists, and insist that our schools should limit the launching of new graduates upon an already crowded profession, because there is not enough of practice for those already in, while themselves neglecting a large proportion of the field that should be covered. Properly to care for the disregarded conditions of the mouths of the people of this country would far more than employ the time of all the dentists now in practice. The proper remedy for a stream that overflows its banks is to widen and deepen its channel, instead of attempting to dry up its waters, and there are unoccupied fields within the province of dentistry not only as yet uncultivated but almost unexplored.

Local irritation is the cause of most of the inflammations and hypertrophies of the gums that are so commonly met with. Usually

FIG. 13.



GINGIVAL HYPERTROPHY AND TURGESCENCE, THE RESULT OF NEGLECT.

this is due to lack of care on the part of the patient. Foreign matter is deposited at the cervical portions of the teeth, and this by its excitant action stimulates the tissues to abnormal activity. The consequence is an overgrowth, an hypertrophy or hyperplasia of tissue. This may be confined to a single tooth, or it may be more widely diffused and involve nearly or quite the whole of the dentition. The tumefaction will be especially pronounced in the gum covering the septum between the teeth, where the irritation is greatest. If there are carious cavities, not infrequently they will be completely filled with hyperplastic tissue, connected with the rest by a slender pedicle. The margins of the gums will be thick, everted, and of a deep red color, almost approaching a purple. There may be a breaking down of the tissue with pus formation, entirely distinct from that condition called pyorrhea. The mucous follicles of the gums are in a degenerative state, and their secretion

no longer properly lubricates the tissues, but adds to the disturbance by its perverted character.

These conditions arise as the effect of lack of care, local irritation due to the presence of foreign substances, rough projecting fillings, or deposits about the necks of the teeth. Diagnosis is not difficult, for the very existence of the disturbance indicates the presence of exciting agents. The first curative measures to be adopted obviously is the removal of any local deposits or foreign substances. Nor is it sufficient to do this superficially. Wherever there is any undue amount of tissue or tumefaction, beneath it, perhaps at the very edge of the alveolar walls, will be found something foreign. It is absolutely essential that the instrument used should penetrate to the point of attachment beneath the inflamed tissue, and to this end one that has a chisel edge, adapted to a pushing motion, will be most effectual, for anything thicker will not reach to the very extremity. It should not be forgotten that the most mischievous irritant matter is that which lies deepest, and nearest the point of actual attachment of the pericementum to the tooth.

Minute spicules of calcific matter are those which cause the greatest disturbance. Whether these have their origin in the fluids of the mouth or of the circulatory system, whether they are salivary or sanguinary, local or constitutional, their operative treatment is the same. That such deposits of hard, sharp, segregated granules beneath the gums differ from the ordinary tartar or salivary calculus that is precipitated upon the supra-gingival portions of the teeth must be patent to everyone, but whether this divergence is due to its derivation, or merely to the manner and place of its deposit, we need not now inquire. Certain it is that its removal is more difficult than that of ordinary salivary calculus. It perhaps will not be detected without the exercise of considerable care, for it sometimes exists in minute granules that would be invisible even if not covered by the inflamed gum.

A solution of trichloracetic acid, of from twenty to fifty per cent. will greatly aid in the removal of these deposits. It may be carried on the edge of a sharp, wedge-shaped piece of orange wood that has been dipped in the solution, or a small rope of cotton may be saturated and with an excavator carefully carried up to the very point of attachment of gum and tooth, and there allowed to remain

for a few moments. While the acid does not remove the deposits by dissolving them, it will loosen their attachment to the teeth, and soften them enough to facilitate their removal with the scaler. At the same time the remedy acts as a slight cauterant, inducing a slough of the superficial parts of the degenerative tissue, and reduction of the inflammatory condition by its astringent and alterative action upon the distended, congested capillaries. A solution of lactic acid has been highly recommended for the same purpose. The patient should be directed to use frequent massage of the gums with the ball of the finger, and the persistent use of a soft tooth-brush should be insisted upon. The mouth should be gargled and the gums washed with a solution of ten grains of chlorate of potash to the ounce of water, and if necessary a solution of chloride of zinc may be prescribed for oral use. If there is a great deal of bleeding, tannic acid may be rubbed upon the gums with the finger. If, as is probable, an antiseptic wash is needed, a solution of boroglycerol in water, one part to ten, may be used as a wash or with the brush. It will not usually be wise to attempt the removal of the deposits from all the teeth at one time, if many are affected.

The medicinal treatment needs repeating at intervals of a few days until the condition is changed, and it is well at each of the visits to explore still further for irritating substances. An indication of their existence and their locality will be found in the local persistence of the inflammation. Any red, irritable point of hypertrophied gum will usually be found to cover the cause of irritation.

Of the inflammations arising from loose or ragged teeth it is unnecessary to speak. The removal of the source of irritation will be sufficient. The gums beneath ill-fitting plates frequently become tumefied, and sometimes sloughing ensues. This is especially the case with rubber plates, not because they generate any heat, but because they are non-conductors and the tissue beneath them is not subjected to the same variations of temperature as the other and surrounding tissues. The condition may sometimes be found beneath metal plates that are not adapted to the mouth, if they are worn continuously, but there is not the same degenerative lack of tone in the bloodvessels that is found beneath rubber dentures. The congestion is usually less intense, and sloughing is more infrequent. The cure for this condition will be found in the construction of a proper denture, and its inter-

rupted use. No artificial plate should be allowed to remain in the mouth over night. The tissues should be given that opportunity for rest and the recovery of their normal tone.

CHAPTER XII.

STOMATITIS.

The word is derived from the Greek "stoma," a mouth, and the termination "itis," inflammation, so that it implies an inflammatory condition of the tissues of the mouth. The term is a very broad one, and may be made to cover very diverse conditions. Its application, however, is usually restricted to the mucous membrane and the soft tissues in immediate relation with it. It is very common in infants, among the lower classes of foreigners especially, and is usually due to bad hygiene or unsanitary conditions. Especially is this the case with those that are artificially fed instead of being nursed by the mother. Either the food is of an improper character, or the nursing-bottle is not often enough scalded or boiled out to prevent the growth of fermentative organisms, and the milk used is thus infected. The rubber nipple and tube are often the source of irritation to the oral tissues. The rubber under the influence of light and heat rapidly commences decomposition, and thus becomes the means of poisoning the mouth; or it may harbor destructive fungi, and these are especially irritating to the mucous membrane.

Follicular Stomatitis, the simplest form, is an inflammation of the mouths of the mucous follicles. It is either accompanied by or will bring about degenerative changes of the mucosa itself, and this may add materially to the irritation. Perhaps but a portion of the surface may be affected, and the membrane presents a punctate appearance—flecked over with red points. With the increase of the inflammatory condition more of the follicles are involved, until the patches become confluent, and the whole surface is tumid and turgid. In this condition the tissues of the mouth look hot, dry, and red. The mouth becomes sensitive, and the child shrinks from its examination. There will, in the earlier stages, be an

excessive slavering, or flow of watery saliva. There will be more or less of febrile disturbance, and the bowels will probably be irregular, a constipated condition predominating. During a later stage the secretions of the follicles become yet more depraved and no longer give the normal lubrication to the parts. The degeneration spreads to the connective tissue, the mouth becomes dry and parched, the bloodvessels are congested and active nutrition is interrupted, the congestion reaches the point of stasis, or stoppage of the circulation, and sloughing commences.

Acute Stomatitis may be induced by improper feeding, aside from unsanitary conditions. The infant that is fed with a food that it cannot digest will be poorly nourished, and all kinds of degenerations may be established. The irritative condition of the digestive tract may produce diarrhea and gastric disturbances which by mere continuity of tissue may extend to the oral mucous membrane, and an ulcerative stomatitis may be established as the result of the atonic, innutritive state, and the spread of the inflammation from the irritated digestive tract.

Ulcerative Stomatitis is merely an advanced stage of the first condition. The mucous follicles become so degenerated that their functions quite cease, and cracks and fissures open in the unlubricated tissues. All the preceding symptoms are aggravated. The child cannot without great difficulty take its food, and what is ingested affords little nutriment, because of the gastric disturbances that are always present. There is a constant swallowing of offensive matter from the mouth, with a wasting diarrhea or dysentery.

About this time the submucous tissue will perhaps become thickened and indurated in spots. Sometimes there will be ptyalism, with a great flow of watery saliva succeeding the dried condition of the oral cavity. The submaxillary gland may become tender and tumid. Small vesicles may appear in the mouth, seemingly filled with a watery serum. These burst and form an ulcer, with a dirty-white slough. The child becomes greatly emaciated, and there is excessive swelling of the oral tissues. The breath becomes very offensive, and the ulcers show a considerable sloughing. Unless speedy relief is obtained, the child will soon succumb through lack of nutrition, as well as to the infectious products of the septic condition.

Aphthous Stomatitis is a form that may attack people of almost any age, and is characterized by some special appearances. Small round or oval ulcers appear upon the reddened mucous membrane of the lips, cheeks, tongue, or gums. They are from one to three lines in diameter, very little depressed, with a yellowish or white floor, and a red, narrow, perhaps slightly indurated, border. Sometimes two or more of them become confluent, thus forming an irregular, large ulcer. When these heal they leave no cicatrix. The aphthæ do not spread like the spots in ulcerative stomatitis, and they are distinctly painful, while the ulcers are not.

Usually there is an increased flow of saliva accompanying them, the mouth is hot and feverish and the tongue heavily coated. Sometimes the saliva excoriates the skin and the lips are thus kept constantly sore.

Thrush is a form of stomatitis occurring in children and dependent upon the growth of a parasitic fungus. This consists of long, jointed threads, the Oïdium albicans, which seems to belong to the family of the molds. Thrush appears to be contagious. On looking into the mouth of young infants a layer of thin white membrane may perhaps be seen covering the palatal arch and appearing as white spots upon the tongue, while the mucous membrane about or at the borders of this coating seems to be in a healthy condition.

Thrush in children is apt to be a sequela of chronic diarrhea, prolonged starvation, exhausting fevers, or any severe and debilitating illness. It is indicative of and usually accompanies a low, atonic condition, and its cure will depend more upon feeding than medicines, first allaying any gastric or intestinal irritation.

Noma, Gangrenous Stomatitis, or Cancrum Oris, is a kind of ulcerative stomatitis, but as the term is usually employed it implies a specially vicious degenerative condition, due to infection by a peculiar bacillus.

The preceding remarks are more especially applicable to infantile stomatitis. The same or analogous conditions may be induced in adults by like causes. Anemic and poorly nourished persons are especially liable to inflammations of the oral tissues. The lips are dry and parched, and superficial fissures and cracks in the mucous membrane appear. In a less degree this will be observable upon the tongue, the buccal surfaces, and in the vault of

the mouth. This may continue for some time, until finally, with the progression of a general febrile state, a more active stomatitis is developed that may result in a local breaking down or ulceration.

Neglect of the teeth and the mouth tissues is a fruitful source of stomatitis in adults. Food is left to ferment and putrefy, and the products of this action will be exceedingly irritative to the soft tissues, as well as destructive to the hard. There will always be gingivitis present in the mouths of those who do not give proper attention to the removal of foreign substances from about the teeth, and this, by continuity of tissue, may spread all over the mouth. Usually the action of the saliva upon the portions freely washed by it is sufficient to keep them clean and normal. But between and about the teeth, where food remains for an indefinite time, in the absence of proper care the gums are always irritated and more or less congested, and this may spread to adjoining tissue, with the result of an acute stomatitis in atonic conditions.

CHAPTER XIII.

TREATMENT OF STOMATITIS.

In infantile affections the very first measures to be adopted necessarily imply an inquiry into the food and feeding. If the child is artificially fed, the nursing-bottle should be carefully inspected, and the food that is given must be scrutinized. If there is anything unsanitary about either, it must be at once corrected. The rubber nipple and tube must be sterilized, or, what is better, discarded and substituted by a new one that has been made thoroughly aseptic. If the child is poorly nourished through improper or insufficient food, that must be remedied, and plenty of nutritious matter that can be readily digested and assimilated should be given. If there are diarrheas or other wasting disorders, which will too often be the case, they must at once be attended to; it will be impossible to build up a patient while any process of waste is going on. All unhygienic surroundings must be remedied, and the patient should be given plenty of light and air, and proper exercise. In short, beneficent Mother Nature, upon whom we

must finally rely for a cure, must be afforded every opportunity. Functional activity must be promoted, and all obstacles removed.

After securing perfect sanitation the local treatment will be mainly depurative and stimulative. If a cathartic is indicated, two drams of castor oil may be administered. For the local irritation, a mouth-wash consisting of a solution of five to ten grains of chlorate of potash to the ounce of water may be used as a gargle. If the child is too young to use this itself, a swab may be made by tying soft linen to a stick of proper dimensions, and this may be used to apply the solution, employing a proper degree of friction. If the mouth is sore, it may be applied with a soft brush. The mouth may be occasionally washed out with the following preparation, especially after eating:

℞—Borax,	30 grains;
Sodium bicarbonate,	1 dram;
Distilled water,	4 ounces.

Or the following may be substituted in its place:

℞—Boric acid,	
Potassium chlorate,	of each 15 grains;
Lemon juice,	½ ounce;
Glycerol,	6 drams.

If an antiseptic is needed, a solution of listerine, one part in ten parts of water, may be used in the same way, or it may be administered internally when diluted with simple syrup. Or the following may be prescribed:

℞—Listerine (Lambert's),	2 ounces;
Glycerol,	1 dram;
Water,	to make 4 ounces.

Sig.—A teaspoonful after nursing or feeding.

If there are cracks in the tongue or fissures in the cheeks, a solution of borax and honey, made by adding one dram of borax to each ounce of clarified honey, may be applied locally.

If there are deep erosions of the mucous membrane, or ulcerative surfaces, it may be necessary to cauterize them, either with silver nitrate, pure carbolic acid, or chromic acid crystals. The last named are preferable in instances in which they can be conveniently used. The cauterized places should be subsequently dressed with a solution of calendula.

The treatment of follicular, or ulcerative, stomatitis in adults

does not materially differ from that in infants, except that more active measures may be used. The remedies may be proportionately increased in strength, and personal care insisted upon. The teeth should be thoroughly cleaned, and all broken or sharp edges removed. A soft tooth-brush should be employed after every meal, and with it should be prescribed some antiseptic wash. A two per cent. solution of zinc chloride may be used as a gargle. At night a spoonful of Phillips' milk of magnesia should be taken into the mouth and rinsed about all the teeth, to be left upon them until the morning. Enough of good nourishing food should be given, and the patient should have plenty of pure air and sunshine.

There is a form of ulcer that is the result of the careless application of arsenous acid in the devitalization of teeth, which may be referred to in this connection. Arsenic is a corrosive poison. It produces its characteristic effects in destroying the pulps of teeth through its corrosive action, and not through congestion and the production of consequent stasis at the apical foramen, because it will promptly kill the pulp of a partially developed tooth in which the root is entirely open, no foraminal constriction having yet been formed, and in which strangulation is therefore impossible. When arsenous acid is insecurely sealed up in the cavity of a tooth, such a defective agent as cotton wet with a solution of gum sandarac being employed for that purpose, it may come in contact with the buccal tissue and devitalize that as it does the pulp, gradually eating its way in until a considerable slough is produced.

When this is the case, the ulcer should be thoroughly saturated with dialyzed iron, to limit the action of the arsenic. It should then be dressed with a solution of calendula, and kept clean and aseptic until it has healed. Should the corrosive effects be manifest between the teeth and reach to the alveolar bone, it will probably induce an osteitis that may end in caries or necrosis. When this is the case the affected bone should be promptly burred away before using the dialyzed iron.

In Gangrene, or Noma, or Cancrum Oris, thorough cauterization or removal of the affected tissue will probably be necessary, and the strictest antiseptic precautions must be employed. For the general symptoms constitutional treatment must be taken. Tonics should be employed, with fresh air and a sufficient amount of exercise. Every possible effort should be made to promote nutri-

tion, and especially that of the locally affected tissues. In fact, when stomatitis reaches the point of deep ulceration or extensive breaking down of tissue, it is such a grave condition that general constitutional treatment should not be delayed.

Sometimes the pulps of teeth assume a gangrenous condition. When this is the case, there is great danger that septicemia and pyemia may be the consequence. Miller details a number of cases within the sphere of his own observation, in which death within a very few days has been the result of the gangrenous infection of a tooth pulp. When the symptoms of general septic poisoning are manifest, no time should be lost in the institution of the proper general remedial measures, the consideration of which is beyond the scope of this work.

In cases of thrush in infants that are badly or insufficiently nourished, there is usually more or less of gastric or intestinal irritation in connection with the markedly atonic condition. This will probably require the administration of such correctives as rhubarb and soda, lime-water, and vegetable bitters. When the aphthæ occur in older persons they are often spoken of as "canker spots," or "canker sore mouth." The usual treatment is roughly to cauterize the spots and dress them with a solution of calendula. If an active cauterant is not desirable, as in children, the aphthous patches may be repeatedly touched with the following solution:

℞—Sodium salicylate,	1 dram;
Distilled water,	6 drams.

Or in place of the preceding this may be used:

℞—Borax,	45 grains;
Sodium salicylate,	75 "
Tinct. myrrh,	1 dram;
Simple syrup,	
Distilled water,	of each ½ ounce.

If the aphthæ exist in considerable numbers, they may demand the use of antiseptic mouth-washes. If they are the consequence of a general anemic condition, tonics and alteratives are of course indicated. While they are peculiarly uncomfortable, the aphthæ have no serious pathological signification, except as they are indicative of an atonic condition.

CHAPTER XIV.

PHARYNGITIS AND TONSILLITIS.

THERE are many pathological conditions of the oral cavity, and of the immediately connected tissues and organs, that should fall within the province of the oral physician or dentist, but which are usually relegated to the general medical man. When the time shall come in which no man will be allowed to enter upon oral practice who is not thoroughly qualified to treat all oral conditions, dentistry will occupy a very different place in general estimation from that of to-day, and there will be plenty of room for all the competent men whom it will be possible for the colleges to turn out. At present, diseases of the pharynx are usually supposed to be beyond the scope of the dental practitioner. And yet there are no specialists to whom such affections should so naturally fall, and there are none who have such opportunities for the observation and detection of pharyngeal lesions. It but needs that these shall be brought within the limits of his practice, and that he shall properly qualify himself for their treatment, to bring great benefits to both the dentist and the people.

The pharynx is a pouch, largely aponeurotic, which is divided into two parts by the soft palate. It has seven openings—that of the mouth, the two Eustachian tubes, the larynx, the esophagus, and the two nares. Its diseases are mainly those of the mucous membrane. There is no more common affection than angina simplex, a common sore throat, the effect of that inflammation that we call a cold. It is accompanied with irritation, huskiness, and pain in swallowing, and its remedy is in cleansing, antiseptic, astringent-stimulating, and anodyne gargles, a solution of chlorate of potash being that most commonly used.

A considerable proportion of pharyngeal affections are the direct results of lesions within the oral cavity, brought about by continuity of tissue. There are certain diseases of the tonsillar glands that are not included in this origin, and there are inflammations dependent upon laryngeal lesions as well, but a considerable number of the affections are due to oral trouble. Complications arising from impactions of the wisdom tooth and its investments

are one of the most frequent of these. Owing to a lack of development, especially in the length of the body of the lower jaw, frequently there is not sufficient room for the eruption of the tooth, and it becomes imbedded in the tissues, a constant source of irritation. Sometimes the inflammation about it is so intense as to prevent the opening and closing of the mouth. At times there is a breaking down of tissue, and suppuration ensues. From the initial point of the lesion, dark-red lines extending down into the pharynx may be observed, and there is a distinct and sometimes an acute inflammation of the pillars of the fauces, with great discomfort, or even acute pain.

In cases of cleft palate there are almost always complications involving the anterior and posterior nares. When these are presented to the dentist he usually proceeds to the construction of some prosthetic apparatus for the purpose of supplying the loss, without any preliminary attention to the soft tissues themselves. In all cases of complete or incomplete cleft, the pharyngeal walls, as well as those of the nasal cavity, are in an irritable, inflamed, hyperemic state. This could not well be otherwise, because they are not protected by the usual palate, and are subjected to the irritating action of food and drink every time it is taken. Not infrequently there are excoriations and abrasions of the edges of the palatal cleft, with degenerative conditions of the mucous membrane of the posterior nares that require active treatment. The oral physician or surgeon seldom notices them, because they do not form a part of the regular practice to which he confines himself.

Inflammations of the pharyngeal tissues, arising from the changes in the neural currents commonly called "taking cold," are quite common. If the tongue is depressed by placing upon it a broad spatula, the whole pharyngeal cavity will appear of a bright-red color, with the parts considerably swollen. The uvula will appear lengthened and pendulous. There will be a dryness in the fauces, with huskiness of the voice and considerable pain on swallowing. The Eustachian tube will apparently be closed, and the hearing will be materially affected.

These simple follicular inflammations usually result in a ready resolution, but their time may be cut short by proper remedial measures. If there are no abscesses or deep erosions, hot pediluvia should be resorted to, with saline cathartics and diaphoretics.

The latter class of remedies is of importance, and a general diaphoresis will usually greatly hasten a cure. Twenty or thirty grains of potassium bromide, with five drops of tinct. veratrum viride, may be taken in a small glass of water, when the patient should go to bed and cover up warm. A gargle of chlorate of potash may be used if the attack is not very acute. If there is any infection, an antiseptic gargle, such as a teaspoonful of phénol sodique in a glass of water, or five grains of chloride of zinc to the ounce of water, may be employed. If there are excoriated surfaces they may be touched with a cauterant.

Tonsillitis.

The tonsils are sometimes severely attacked by parenchymatous inflammation. Where this is comparatively slight, a careful examination may be necessary to distinguish it from some forms of pharyngeal inflammation. But there are instances in which the tonsils become so greatly inflamed as to prevent swallowing and to impede breathing, and active scarification becomes a necessity. Usually, however, the swelling may be allayed by a phénol-sodique gargle, or one of which sodium bicarbonate forms the base. If there is much pain the tonsils may be painted over with a cocain solution. If suppuration ensues despite all measures to prevent it, the pus should be voided as soon as possible, and the usual antiseptic treatment follow.

In tonsillitis of an especially acute character Prof. F. J. S. Gorgas recommends the following prescription:

℞—Acidi gallici,	gr. xl;
Liq. sodæ chlorinatæ,	℥ij;
Glycerol,	℥ij;
Aquæ dest.,	℥viij. M.

Sig.—To be used as an antiseptic and astringent gargle.

It should not be forgotten that the tonsils are frequently marked with deep sulci and furrows, especially if they have been the seat of repeated attacks of septic inflammations. These depressions form favorable harbors for the proliferation of different forms of pathogenic and saprogenic bacteria. When this condition is observed, great care should be exercised to keep the external surfaces of the glands in an aseptic condition, lest the suppurative condition commonly called quinsy become chronic.

CHAPTER XV.

DISEASES OF THE TONGUE.

Properly read, the appearance and superficial condition of the tongue is an index to most gastric and to many other general disturbances. In health it is of a delicate whitish pink color, smooth and moist. Any departure from this appearance indicates a pathological condition, not necessarily of the organ itself, but of others whose disturbed state is reflected upon the tongue, and especially of functional aberrations which interfere with digestion. It may be covered with the so-called "fur," which is a coating made up of the epithelial scales that have not been thrown off, of certain granular matters, of inspissated or degenerate mucus, and of detritus. The investment of the tongue with this coating always commences at its base, and gradually invades the dorsum until the tip is reached. The clearing up of the tongue during convalescence is from the tip and borders toward the base, so that the progress or recession of this coating will furnish an index to the condition of the patient from day to day. A furred tongue is a symptom of a defective circulation.

In addition there are certain well-established appearances that are indicative of special pathological conditions:

Extreme humidity—Indicates atony, with anemia.

Extreme dryness—Nervous irritation or weakness.

Flabbiness or tremulousness—Extreme weakness.

A grayish white color after eating—Normal digestion.

A yellowish white—Acidity, with biliary irritation.

Very white, thick coating ("flannel mouth")—Intense venous congestion.

A delicate pinkish red—Digestion completed.

A deeper hue of red—Arterial congestion; irritation.

Very deep dark red—Active inflammation.

Bright red, raw or glazed—Approaching fatal exhaustion.

Brownish red, with thick dry coating—Prostration; danger.

Black, not a deep hue—Blood poisoning; pyemia.

Bluish tinge—Cyanosis; lack of oxygen.

The indications upon the tongue of a dangerous condition are

tremulous action, extreme dryness, blueness, a very red, shining or glazed aspect, and heavy furring of a dark or black hue.

In considering the tongue as a diagnostic organ, however, its indications are not to be depended upon alone. Its appearance should always be studied in connection with other symptoms, which may dominate the decision. It is to be considered only as an important auxiliary in arriving at a conclusion.

Of itself the tongue is subject to many pathological conditions. It is manifestly impossible within the limits of a work like this to consider all these, or to do more than to note those degenerations that are of greatest interest to the oral specialist. The remainder more especially belong to the general practitioner.

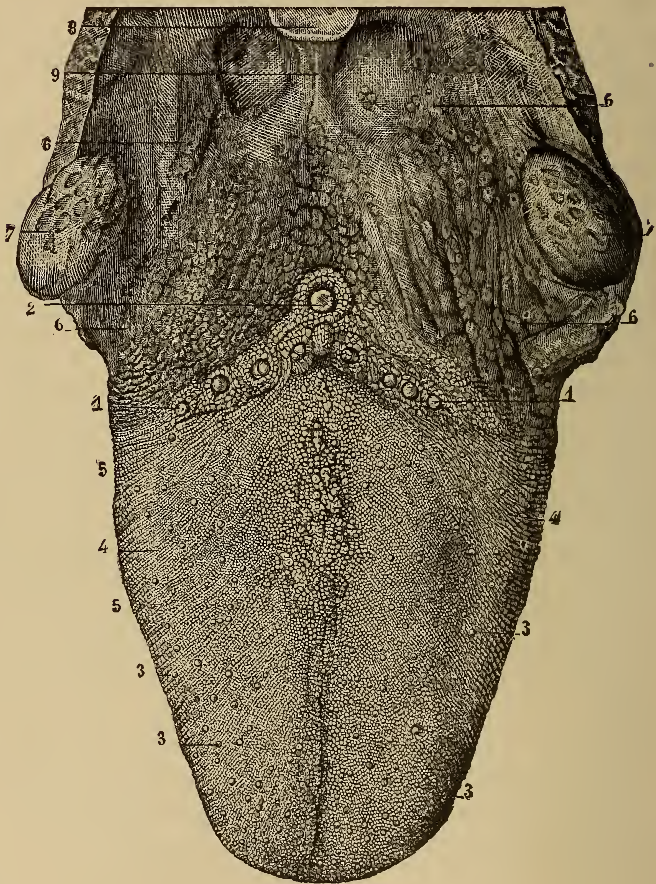
Glossitis, inflammation of the tongue itself, whether sympathetic or idiopathic, is a disorder which may occur at any time. When it is the result of some injury or traumatism, it especially appeals to the oral practitioner. The tongue may be wounded by the careless use of instruments, and great inflammation may be the result. An excavator or bur that has been used in a gangrenous tooth pulp may wound the tongue and cause alarming symptoms as the result of the septic infection; a very short time may suffice to cause such an intense infiltration that suffocation will appear imminent. The swollen tongue may fill the mouth to the utmost point of distention. The general system may sympathize and the pulse grow rapid, a feverish condition supervene, and a state ensue that causes the most intense anxiety, from the alarming symptoms presented.

An acute glossitis will usually, however, end in complete resolution without such startling symptoms. It may be necessary, and it is usually advisable, to administer an active cathartic, and to promote diaphoresis by means of potassium bromide, or Dover's powders, with warm drinks. If there is a septic wound it should be opened to its bottom, to permit the escape of any infectious products. If the swelling assumes dangerous proportions, no time should be lost in making deep incisions into the body of the tongue. These should not be long or continuous, but merely deep punctures with a bistoury, and as many as may seem indicated.

Syphilitic ulcers, swellings, cracks and fissures, indurations,

hypertrophies, etc., are comparatively common, but their consideration need not engross our attention at this time.

Fig. 14.



The Tongue.

1. The Circumvallate Papillæ, or Papillæ Maximæ. 2. The Foramen Cecum. 3. Fungiform Papillæ, or Papillæ Mediæ. 4, 5. Filiform Papillæ, or Papillæ Minimæ. 6. Intertonsillar space, with numerous follicles. 7. The Tonsils. 8. The Epiglottis. 9. The Frenum.

Injuries from the teeth are not uncommon, and sometimes result in degenerative conditions of the gravest character. The tongue is perhaps irritated by the sharp edge of a decayed or broken tooth, and a thickening of the tissue, with induration, fol-

lows, even though the mucous membrane is not broken. The irritation being kept up, the scirrhosis increases until there comes a time when it breaks down in the center, an indurated border yet remaining. This may present the appearance of syphilitic gummata, and may have consequences almost as disastrous. No dentist should leave in the mouth any such tooth, if it falls under his observation, for it may result in a serious complication. When such a thickening is found all source of irritation should be removed, and if it does not disappear it may be necessary to remove it by surgical interference, lest it assume a malignant form.

If an eroded ulcer is the result of such a sharp tooth, and if upon removal of the cause it presents an indolent appearance, a chloride of zinc wash of not more than ten grains to the ounce of water may be used, or one made by the addition of a little compound tincture of capsicum in water. Violent, or drastic, or surgical measures should not, however, be lightly resorted to. Plenty of time should be given for nature to bring about a cure, and general measures, like tonics and alteratives, should be resorted to, lest too active local interference bring about the very state that it is desired to avoid.

CHAPTER XVI.

DENTITION: GENERAL CONSIDERATIONS.

The subject of dentition has not heretofore received the thoughtful consideration at the hands of either dentist or physician which its magnitude warrants. The general practitioner is apt either to consider it a mere physiological process which demands no attention whatever, save in a few very exceptional instances superficially to lance the overlying gum, or without special deliberation heedlessly to charge to its account almost any of the disorders which occur coincidentally. On the other hand, the dentist, like all other specialists, is inclined to discover within the limits of his own field the proximate or direct cause for almost every ill to which flesh is heir. This is but natural. His life is devoted to the study of certain organs, and he knows how close is their functional relation to other parts of the body. He is certainly more likely to be right

than the man who has no special or intimate knowledge of that particular subject, but there is danger that he may exaggerate its importance as one of the factors in vitality. That which is nearest our eye may eclipse much larger but more distant objects. To learn their proper relative importance a view must be taken from another standpoint.

The purpose of this chapter is to determine, as far as possible, the influence of the advent of the teeth upon other functions of the body, to point out the complications which may arise in their growth, and to correct the impression so often conveyed by physicians that disorders in no way related are the result of a dentition which may be entirely normal. The author is but too well aware that he is not, on this question, in entire accord with either the average dentist or physician, the one, as he believes, too often exaggerating, and the other misapprehending its functional significance. If, therefore, he assumes to speak in a somewhat controversial manner, it is that he may consider the subject from another than his own standpoint. Let there be no misconception. He does not in any way wish to be comprehended as urging that dentition is but a minor matter, or that its possible importance has been in any way, by anyone whatever, overestimated. It is, however, quite possible that inquiry has been wrongly directed, and that the scope of its influence has been in some instances misconceived.

The period of dentition is a transitional one. It is the time when, under normal conditions, the child is gradually habituated to the reception of food that is extra-maternal,—that which has not already by the mother been digested and transformed into a pabulum which is adapted to the undeveloped organs of the infant. It should be comprehended that during this period it is not alone the teeth which are growing. Organs are developing simultaneously that are far more important, in that they are absolutely essential to life itself, and without which existence cannot even for a short time be maintained. If it is true, then, that the development of the teeth under usual conditions is likely to produce such serious disturbances as are sometimes charged to it, what shall be said of the growth and functional changes taking place in the digestive tract, and what of that marvelous transformation in the heart which occurs at birth, or that of the genital organs which takes place later in life? We must not fall into the error of attributing to the

growth of the teeth all the phenomena of the period, ignoring the fact that other organs are passing through a like developing stage. It must be remembered that the beginning of the formation of the teeth goes back to a very early period of fetal existence, and is contemporaneous with that of the heart and the lungs. The mere eruption of them through the gums is but a single incident in their progression, due to rapid growth of the cementum and dentine, and is simply one of the eras of spasmodic developmental activity through which all bodily organs pass. Why should such infinitely greater stress be placed upon the advancement of the teeth than upon that of all the other organs of the body, when, as is presupposed in the preceding paragraphs, no specially abnormal or unusual conditions exist?

That anomalous and unnatural presentations of the dental organs are more common than are lesions in other like developing ones is undoubtedly the case, and it is from this standpoint, and from this alone, that the magnitude of the subject is apparent. But that, grave as may be the complications which produce certain definite functional disturbances, to them shall be attributed the most diverse disorders, and those whose etiology may be so much more readily discovered in other functional disturbances, seems not very reasonable or rational. The sole question at issue is not whether dentition may induce grave systemic disorders, but whether it is responsible practically for all of them. There can be no denial of the fact that it may produce serious reflex complications. Phimosis may do the same, but is it possible that either is the cause of those whose origin is in direct instead of reflex influences? Children may, and often do, die from maladies induced by teething. But is that solely, or even chiefly, responsible for the terrible mortality of childhood? That is the problem to which this and the three succeeding chapters are devoted.

It is urged that infant mortality may be very largely due to the lowering of vitality, and a diminution of the resistive force of the healthy body against disease. That the reduction of the vital potential caused by the nervous strain incident to irritation of the dental papillæ may so weaken function that when any digestive irritation is encountered the little patient at once succumbs,—this must be conceded by all. But to make of it the principal factor in the great mortality of childhood, the exclusive view of the specialist,

to which objection has already been raised, must be adopted, and the developmental disturbances which may arise in all other organs must be ignored. It also assumes that in a large proportion of instances dentition is abnormal, an hypothesis that is by no means proved. In this view it would appear that the influence of dentition in causing the digestive disturbances to which the great mortality of infancy is so largely due may very easily be exaggerated.

That in reflex nervous action may be found the origin of many infantile as well as adult disturbances it is one of the objects of these chapters to demonstrate. No physiologist or pathologist of intelligence and reflection will be likely to lose sight of this. But it is also the object to draw a line between disorders that evidently are or readily may be due to direct functional disturbances, and those which are more recondite in their etiology. Reflex disturbances will induce reflex symptoms, and the student is herein urged to consider them very carefully. He is taught to distinguish between the reflex and the direct, and that principal object is kept steadily in view. The appearances objectively presented when dentition is not proceeding normally are detailed, and the symptoms which reflex nervous action will offer are considered. If a diarrhea can in any way be traced to dental irritation, no one will dispute that it must be through reflex nervous conditions, nor that it must present or be accompanied by reflex symptoms. That is the sole point at issue. Shall we in discrimination inculcate the importance of distinguishing between the two, or shall we, without any special study of the case or consideration of the circumstances, continue to attribute to that which may be proceeding normally disturbances in other organs in which we know function to be deranged? Children may die of digestive disorders induced through reflex disturbances of dentition. The sole question is, Can we charge to this sole cause all the frightful mortality of childhood, when we should know but too well that other more powerful factors are engaged?

CHAPTER XVII.

THE DISEASES OF DENTITION.

THE fact that a considerable portion of the human family die before they have reached the period at which the last of the deciduous teeth shall have been erupted, and that the time of greatest mortality is that during which the teeth usually make their appearance, has led to the popular belief that the one is necessarily dependent upon the other; that dentition is the almost exclusive cause of the high death-rate among children, instead of more frequently being merely coincidental. That it is possible for a retarded or disturbed dental development to induce very serious derangement has already been affirmed, but that it is the principal factor in inducing the great number of deaths that occur in children from digestive disorders can scarcely be maintained. There are many cogent reasons for the contrary belief, while there is nothing, save the mere fact of coincidence, to sustain the theory too commonly accepted without inquiry or consideration.

There is a lack of comprehension as to the true character of the diseases that cause this high death-rate in children. Digestive derangements are not the main factor, and yet, if we except nervous disorders, these are the only ones that can with propriety be urged as the possible result of disturbances in dentition. Statistical summaries nowhere give the cutting of teeth as a cause of death. Although the reflexes due to disordered dentition undoubtedly in some instances may be the real proximate, if not the direct, cause of death, it is impossible always to distinguish them from other reflex disturbances, and, in any case, statistics cannot pretend to present more than the immediate cause. Hence they must always be accepted with these limitations. But, the fatal lesion being determined, it is comparatively easy to discover whether reflexes may readily induce it, and from these probabilities determine their influence in any given table. For instance, no one will urge that they can play any important part in the zymotic disturbances which are chiefly chargeable with the majority of infantile deaths, while in affections of the brain, heart, or kidneys they might be frequently responsible. But granted that a brain trouble is due to reflex irritation, it is by no means established that the source lies in the teeth.

The following tables will be found very instructive in the study of mortality. They are derived from reliable sources, and are presented in the hope that they will afford assistance to those who desire to investigate for themselves, rather than to obtain all their information at second-hand. The traditionary instruction given in medical schools is that the teeth are the one important factor in producing the high death-rate of infancy. It is the imperative duty of dentists to examine the facts, and to inquire if this hypothesis is not founded in error, due to insufficient study and knowledge, like that other assumption of certain medical authorities, that pulpless teeth are the principal source of disease of the maxillary sinus, and a continual menace to health.

Percentage of probability that a child born alive will die of different diseases.

Phthisis	.1144	Diphtheria	.0049
Diarrhea and dysentery	.0343	Brain diseases	.1218
Typhoid	.0381	Lung diseases	.2640
Scarlet fever	.0300	Stomach and liver diseases	.0524
Whooping-cough	.0151	Heart disease and dropsy	.0766
Measles	.0128	Kidney diseases	.0149

This shows that diseases of the lungs, which include phthisis, are the most fatal, and that more than twice as many people die of brain disease as of stomach troubles.

Mean age at death of people dying from various diseases.

	Males.	Females.	Mean.
All causes	28.2	30.8	29.5
Whooping-cough	1.7	1.8	1.75
Measles	2.5	2.8	2.7
Croup	3.1	3.2	3.15
Diphtheria	7.7	8.1	7.9
Scarlet fever	5.2	5.6	5.4
Smallpox	13.2	10.6	11.9
Diarrhea	11.8	14.9	13.4
Cholera	30.4	32.4	31.4
Erysipelas	35.7	32.8	34.3
Rheumatism	39.8	41.4	40.6
Influenza	42.8	48.8	45.8
Carbuncle	59.2	57.2	58.6

This table indicates that the diarrheas are not confined to childhood, but that they are most destructive in middle life.

Average infant mortality in different countries. Percentage of the population dying under five years of age.

Norway	17	France	31
Ireland	17	Prussia	32
Denmark	20	Holland	33
Scotland	20	Austria	36
Sweden	20	Spain	36
England	26	Russia	38
Belgium	27	Italy	39

This table shows that in the warmer and more thickly populated countries infant mortality is greater than in those lying farther north, and which have fewer people to the square mile. In this connection the following table will be of interest:

Death-rate per 1000 under increase of the population to the square mile.

Population to sq. mile	166	186	379	1,718	4,449	12,357	65,823
Death-rate at all ages	16.94	19.18	21.90	24.81	28.02	32.96	38.67
Under 5 years	37.80	47.53	63.06	82.10	94.04	111.90	139.52

This table shows that with an increase in population the death-rate in young children is very much greater than in adults.

Number of births in the several months of the year in different countries, 100 being considered the general normal average.

	France.	Germany.	Spain.	Italy.
January	105	103	114	107
February	111	105	108	114
March	109	103	112	110
April	106	100	102	106
May	99	97	100	95
June	95	95	89	89
July	96	96	88	91
August	96	98	91	93
September	97	106	98	100
October	95	100	100	98
November	97	100	97	98
December	95	99	100	97

It is only in the older countries that these statistics, which are compiled from government records, are kept. In America the census reports have not until lately been thus complete. The lesson to be learned from these presentations is, that while birth-rates do not widely differ, the death-rate is subject to many contingencies. The diseases of which children mostly die are not those which could be materially influenced by the cutting of teeth, but are due either to organic lesions or to contagious disorders, in neither of which can dental disturbances play any important part. As has already been stated, nowhere is the cutting of teeth statistically given as the direct cause of mortality. Although it may in some instances induce death through some other complication, its influence has been considered either too remote or too insignificant to be included as a separate cause.

All these facts should lead us to give close scrutiny to the assertions of those who claim that any considerable number of infants die from cutting teeth. A distinction should be clearly drawn between the "so-called" diseases of dentition, which may be digestive disturbances, and those that are actually produced by mal-development of the teeth, whose pathological history is quite different. The former class of derangements may properly belong to the general practitioner, while the attention of the oral pathologist should be more particularly directed to the latter. But as it is essential that both should be comprehended to make a clear diagnosis, each must in turn be considered, and they will for convenience be divided into the "so-called" and the "true" disturbances of dentition.

CHAPTER XVIII.

THE SO-CALLED DISEASES OF DENTITION.

Those which we may denominate imputed diseases of dentition are the diarrheas, dysenteries, and fevers of infancy, which are true digestive disorders, and instead of having their etiology in the advancing teeth, arise from improper feeding during the period of most active development. All growth, whether in the vegetable or animal kingdom, is by alternate periods of activity and repose.

In plants, winter is the season of rest and of the gathering of forces for the season of advancement. With the spring comes the period of growth, when the organism assumes an extraordinary energy. The leaves are put forth, and each twig shoots out with an amazing activity. The whole advance of a year is then made within a few weeks. But the tissue so developed is soft and succulent, without the woody structure that gives it strength and consistency. The summer, when increase and extension have ceased, is devoted to the maturing and consolidation of the newly formed material, while in autumn all the energies of the plant are employed in perfecting the fruit or seed by which the preservation of the species is insured.

The growth of the plant is analogous to that of the animal. Vegetable physiology does not in essence differ from that of the sentient being. The latter has also its periods of increase, of active expansion, and those devoted to the maturing and perfecting of that already formed. Many people have observed that children, after a period of seeming suspension of development, may within a few months add an inch or more to their stature. This is succeeded by another term of rest, when the tissues pass through a process of maturing. It is well known that during these terms of rapid growth young persons are more liable to injuries and illnesses of different kinds than they are either before or after them. It should not be forgotten that the teeth, like the other organs of the body, have their distinct eras, and that they develop with the rest of the body, and not independently of it. When the child is cutting its teeth, at the same time it is practically getting a new stomach and new digestive organs. Local causes aside, if the muscles do not develop, the jaw and teeth will not grow, for all are dependent upon the same digestion and assimilation of food.

In the newborn infant none of the tissues are sufficiently developed to perform independent function. The muscles of the legs will not support its weight, and those of the arm are not sufficiently advanced to give it co-ordinate action. The nutritive apparatus is as yet so imperfectly organized that it cannot fully digest food, and the child must be given pabulum that is already partly prepared for assimilation. It finds this in the greatest perfection in the milk of the mother, in which all the elements necessary to growth are held in solution in a condition exactly adapted to the

state of development of the child. At birth this milk is less highly organized than it will be six months later. When the physician seeks a wet-nurse for a newly born infant, he does not choose one whose child was born six months previously, because her milk would be of such a character that the weak organs of the young babe could not finish its digestion. The milk of one who has been a mother for two months would be too highly organized for the babe of a week.

Nature has made all provision for the regular development of the child, and as its digestive organs become better developed the milk of the mother changes accordingly, until by regular progression, through successive advancing periods of growth, the various organs are sufficiently perfected for independent existence, and food that is partially digested is no longer a necessity for healthy functional action. This will only, in normal conditions, occur when the other organs are as far advanced as the digestive tract. The muscular system will have enough strength to enable the child to perform necessary motion. The brain and intelligence will be adequate to the proper selection of its food, while the teeth will be in a sufficiently advanced state to prepare the pabulum that is proper for its condition. As after this the body gradually develops, so that more highly organized food becomes a necessity, additional teeth are given, the small ones of childhood are succeeded by those larger and stronger, until with the period of full puberty the dentition is completed simultaneously with the perfection of the other organs.

Unless the regular gradation of food keeps pace with the evolution and progressive growth of the organs, all the processes of nature are deranged, function is interfered with, and disease is the result. If the young child, with its digestive apparatus but little developed, is given food too highly organized, indigestion, with its consequent vomitings, diarrheas, and febrile disturbance, will be the result, and it is here that the "so-called" diseases of dentition largely have their origin. With the advent of the deciduous incisors, the muscular system is sufficiently advanced to allow the child to sit erect, and in the average family it is taken to the table at meal-time. The injudicious or ignorant mother places in its mouth some soft food, fit only for adults. The instinct of the child teaches it to reject the offered dainty. The sense of taste

has not yet been wholly developed, nor will it be normally until the organs are sufficiently advanced for full digestion, and so the morsel is ejected with a wry face. But the mother persists, and after a time it is swallowed. Perhaps a morbid, abnormal appetite is stimulated, much as later in life one for whiskey or tobacco or opium is acquired.

The bolus having been swallowed, it must lie in the elementary stomach as undigested as if it were leather or rubber. It is perhaps regurgitated, and thus expelled from the system. If the bad feeding is persisted in, this means of rejection is soon exhausted, and the foreign matter remains in the stomach, a continual irritant, until it is violently passed through the pyloric opening and into the tender duodenum. Thence, by its irritating action as a foreign substance, it induces the violent peristaltic movements which, when kept up by successive invasions of the irritant, become a pronounced diarrhea, possibly to degenerate into a dysenteric condition, with final death.

And this, because it occurs about the period when the teeth are erupting, is ascribed to dentition. As well might puberty in the male be imputed to the growth of the whiskers, because they begin to appear at about this time. It is essential that the oral pathologist should have correct views upon this subject, and hence some time must be devoted to its consideration. There are a number of cogent reasons why the prevailing belief among physicians that diarrheas and other digestive disturbances are due to advancing teeth is erroneous.

In the first place, their connection is remote, while that between the diarrheas and improper feeding is so close that the probabilities are greatly in favor of it as the cause, even on other than physiological grounds.

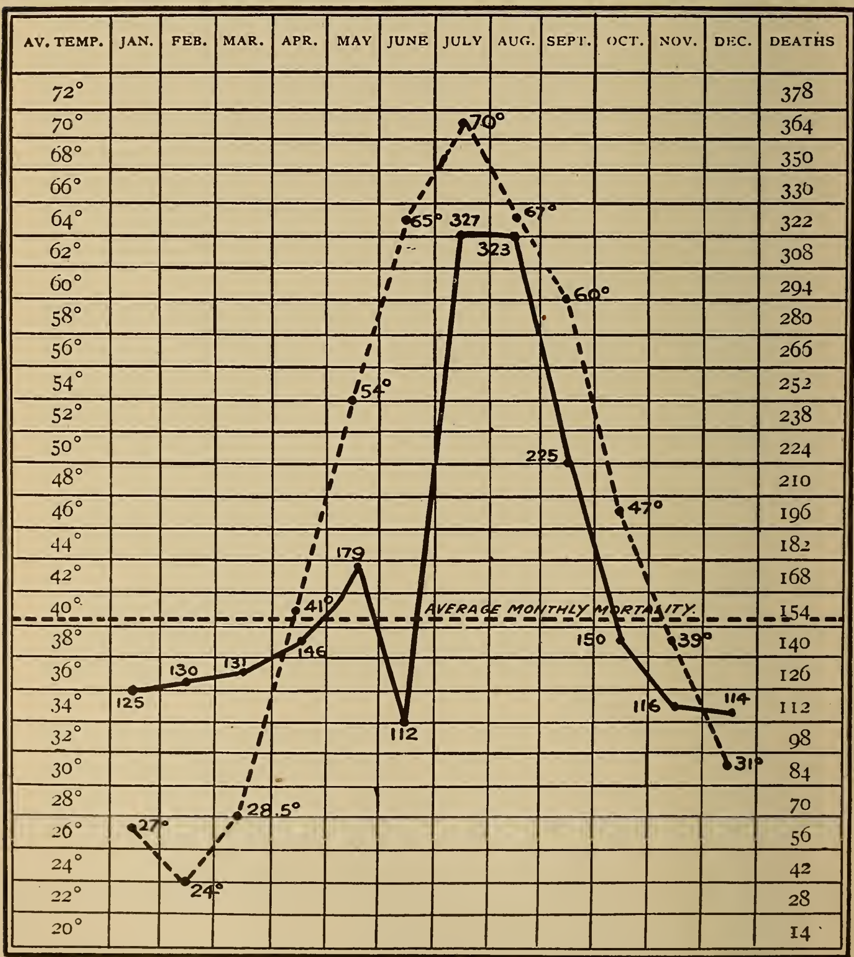
The growth of the teeth is as much a physiological process as is that of the hair or nails. Their development commences some time before birth, and continues for a long time after it. The mere erupting of the organs is but an incidental step in the process, and by no means its most significant or important one. Why should the growth of the teeth not induce disturbances of nutrition before birth, if it does after?

The so-called diseases of dentition are confined to a comparatively small portion of the year, and that is precisely the period

when a change in the food of infants is most liable to be made in the average family, while dentition goes on all the year alike. There are as many teeth cut in January as in July, but the "so-called" diseases of dentition are as one to a hundred. This is

TABLE I.

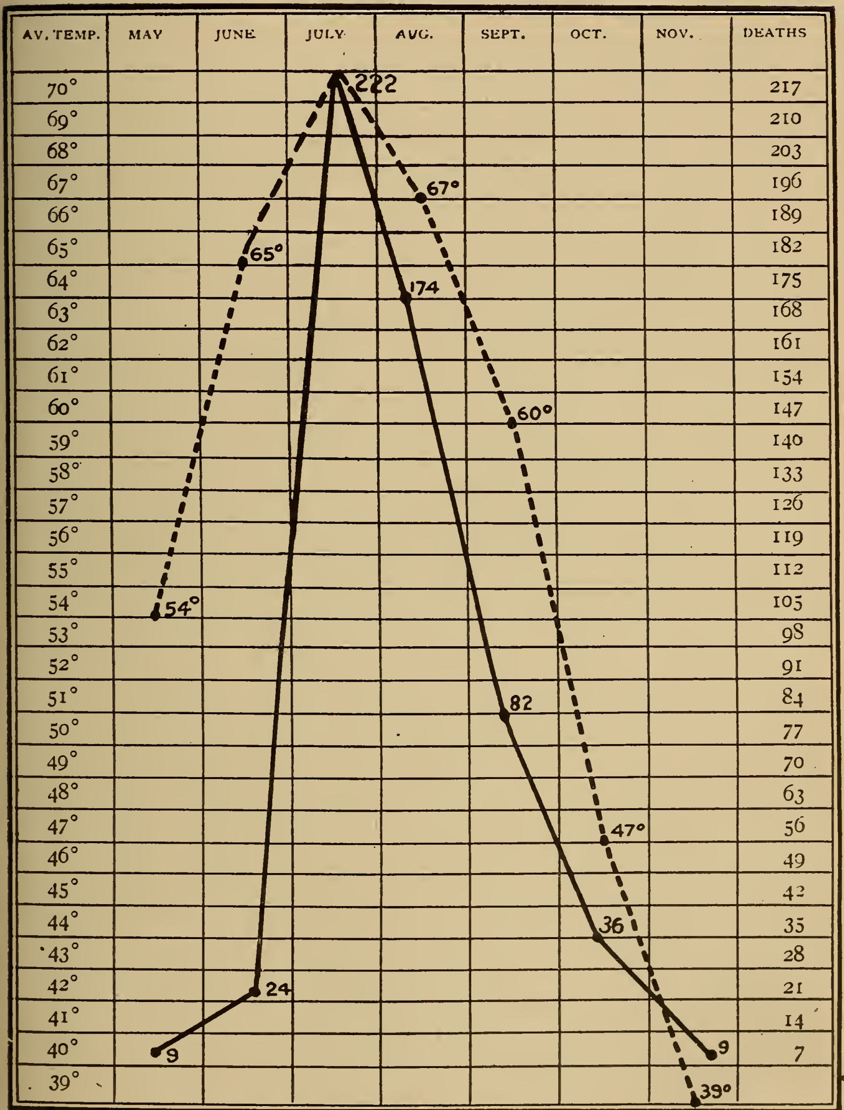
Death-rate, from All Causes, of Children under Three Years, in the City of Buffalo, for the Years 1888, 1889, and 1890.



The interrupted line indicates the average temperature, the continuous line denoting the rise and fall of the death-rate.

TABLE II.

Mortality from Diarrheal Diseases in the City of Buffalo for the Years 1888, 1889, and 1890 for the Months Named.



The interrupted line indicates the average temperature, the continuous line denoting the rise and fall of the death-rate.

abundantly demonstrated by the accompanying diagrams (see pages 78 and 79), which represent the mortality of the city of Buffalo for three years. What is true of that city is true of all others, except as the tables for the different months may be a little modified by latitude.

From November to May, in the northern temperate zone, the death-rate of children from diarrheas and other digestive disturbances is about the same with each month. With the latter month it begins to rise, shoots upward with an amazing increase during June, and reaches its highest point in July. In August it falls slightly, rises a trifle in September, and then falls as rapidly during that month and October as it rose in June and July, again reaching the low point in November, where it remains until the succeeding May. This is more or less true of all cities. Statistics show that the rule is general, but it is especially applicable to the poorer people, and the diarrheas and dysenteries are most fatal in the wards and districts in which they chiefly live.

The diet of the average workingman's family is necessarily restricted in its character during the winter. In April may be seen by the wayside, and in the yards and in fields, his wife and children gathering the early herbs, dandelion, plantain, and others, to boil for greens. These form a welcome change of diet and are appetizing. What is grateful to their own palates, they argue, must be good for the baby, and it is fed from the family dish. Digestive disturbances commence, and they are intensified by giving it other early vegetables, and perhaps stale fruit. There is a period of incubation of the disease; it gradually increases in intensity, but death is not reached until the hot weather of July exacerbates the condition, and perhaps adds some kind of fermentative infection as the immediate cause of the death, the first degenerative step having been taken in the improper feeding of April or May.

The teeth have been erupting during this time, and the unreflective physician, if he is called in, will quiet the anxious parents and friends with the old plea of teething, perhaps lancing the gums when no tooth is near eruption, and neglecting the organs really at fault, until the sexton closes the scene by burying the fatal mistake beneath the churchyard turf.

CHAPTER XIX.

TREATMENT OF THE SO-CALLED DISEASES OF DENTITION.

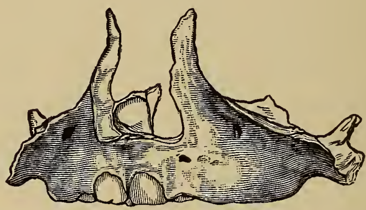
It is the first duty of the dentist or the oral physician, when he is called to examine the mouth of a child suffering from the imputed diseases of dentition, carefully to examine and see if there are any indications of disturbed dentition. A correct diagnosis can only be made with certainty after a very careful consideration, not only of the child itself and the attending symptoms, but of its past history, its sanitary environments, and its diet. The age should be accurately determined, that it may be seen whether the dental development corresponds with that of the general system. This is important, because it is not infrequent that morbid conditions are ascribed to teething when the teeth due at the time are all in place. A medical journal reports a case of infantile palsy in a child more than three years of age, as due to teething. Both legs were cold and powerless. There was sufficient irritation of the gastrocnemius muscles to cause a permanent contraction, thus producing a kind of talipes equinus. Nothing is said about the state of forwardness of the dentition, but unless it was unusually delayed, the physician, as is too often done, jumped at his conclusions and ascribed to teething a trouble that must have had a deeper origin.

The condition of the gums should be carefully noted. If they are normal, without any special inflammation or thickening, we should look elsewhere for the source of the irritation. It should be remembered that the gum is naturally very hard and dense, from the large amount of fibrous tissue in it. Normal growth, when the tooth is near the point of emergence, will find the gum whitish, glistening, and tense in appearance. There may be such a condition of impermeability, of toughness and hardness in the gum that the advancing tooth is retarded thereby, and hence undue pressure is brought to bear upon the, as yet, insufficiently protected pulp, thus inducing reflex nervous disturbances; but unless there are either general or local disturbances that seriously interfere and require immediate attention, the tooth easily makes its way through the gums, by their absorption under the slight but continual pressure induced by the developing roots which lift the crown.

A clear distinction should, then, be made between those diseases which are, or even may be, the results of improper feeding, and the nervous disturbances caused by retarded or impeded dentition. Physicians are year by year more clearly recognizing this difference and governing their practice accordingly; yet by far too large a proportion of them still refer the diarrheas and fevers of childhood to teething, and make no special efforts to correct the vicious diet which may be the source of the disturbance.

The treatment of the so-called diseases of dentition properly comes within the province of the medical man; yet so frequently are young children who suffer from bad feeding brought to the dentist for advice or gum-lancing, that some practical general directions may with propriety here be given.

FIG. 15.



NORMAL APPEARANCE OF THE UPPER JAW AT THE BEGINNING OF THE ERUPTION OF THE DECIDUOUS TEETH, SHOWING DISTENTION OF THE BONY WALLS. (Tomes.)

If the gums present their natural light pink, tense, hard, glistening appearance, it matters little whether there are or are not indications of an advancing tooth, the presumption is that there is another cause for the trouble. Retarded or disturbed dentition will usually leave an index upon the tissues about the point of irritation, and there will be found some departure from the normal appearance. There probably will be local inflammation, turgidity, and tumefaction, with redness and soreness. In the absence of these, the diet should be very carefully looked after, hygienic conditions inquired into, and in case of any departure from that which is proper, the food should immediately be changed and correct sanitary conditions established.

If there is a simple diarrhea, of not long continuance, with little of pyrexia, or fever, a simple correction of the diet will probably be sufficient. If the mother shall have weaned the child,

or her milk is insufficient, some one of the peptonized foods should be substituted. There are so many of these, chiefly proprietary, that it is scarcely proper to recommend any one above the others. It should be something of a very simple nature, in which digestion has already been begun by partial peptonization, or the diastatic action of some proper digestive ferment.

A mild cathartic may be needed, and this is sometimes the first necessity, that the stomach and intestines may be relieved of irritating material. Castor oil in doses of from one-half to one teaspoonful may be given. This will especially be indicated if the stools are of a green appearance. If, as will probably be the case, there is an acid condition, the following may be prescribed:

℞—Castor oil,
Calcined magnesia, of each equal parts.

Sig.—Dose, half teaspoonful, to be repeated in three hours if necessary.

Or the following:

℞—Pulv. ipecac.,	gr. ss;
Pulv. rhei,	gr. ij;
Sodæ bicarb.,	gr. xij.

Fiat chart. xii.

Sig.—One every four to six hours for a child of one year.

If there are no special inflammatory symptoms, the following may be used for the purpose of checking the discharges:

℞—Tinct. opii,	gtt. xvj;
Bismuthi subnit.,	ʒij;
Mist. cretæ,	ʒjss;
Syr. simp.,	℥jss.

Sig.—Shake well, and give in teaspoonful doses every four hours.

If spasms are imminent or present, the following may be used:

℞—Potas. brom.,	gr. iij;
Tinct. cantharidis,	gtt. iij;
Spts. camphoræ,	gtt. x.

Sig.—Repeat p. r. n. in water.

In simple diarrhea, after an evacuation of the bowels, the following may be prescribed:

℞—Bismuthi salicylat.,	ʒj;
Pulv. ipecac. et opii,	gr. x;
Pulv. aromat.,	℈j.

Fiat chart. xii.

Sig.—One powder every three or four hours for a child of one year.

If the stools contain mucus and blood and are jelly-like, the following may be given:

℞—Hydrarg. bichloridi, gr. ¼;
Liq. potas. arsenitis, gtt. xxxij;
Syrupi rubi,
Syrupi rhei, āā ℥ij;
Listerine, ad ℥ij.

Sig.—Fifteen to twenty drops every two hours. If there is much pain, add one-half dram of deodorized tinct. of opium to the mixture.

If there is considerable fever, Dover's powder may be given in small doses of one to two grains, or potassium bromide in five-grain doses. Sponge baths with tepid water will be found useful, and in extreme cases alcohol may be added.

But the change of diet, and the most careful sanitary precautions as to the cleanliness of the nursing-bottle, if such is used, and of all the surroundings of the child, will be the chief care of the physician. Lancing the gums, or other operative procedures, in these instances will not be found necessary and should not be advised. Usually the case will be put in the hands of a general practitioner, but the dentist should be competent to prescribe in his absence, or in an emergency.

CHAPTER XX.

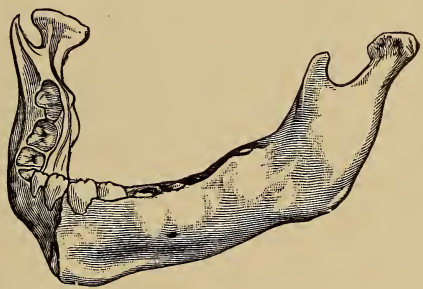
THE REAL DISEASES OF DENTITION.

The real disturbances of dentition are the pathological conditions accompanying the advent of the teeth, in contradistinction to those which arise from improper feeding. Both are sometimes of the most serious character, but their origin and the phenomena that they exhibit are quite different. Usually, with the eruption of the tooth, the superincumbent tissues are absorbed away, and give place to the erupting organ. It should be remembered that up to this time there has been no formation of alveolar process; the bony walls that envelop the germ are very thin and slight, and they are not closed over it. (See Figs. 15 and 16.) There is very little if any pressure, the fibrous gum tissue offering the only obstacle to advancement. In normal conditions this is readily

absorbed, but there are instances in which, through some malformation of the tooth or imperfection of its tissues, or perhaps because of local disturbances, considerable pressure is exerted upon the tooth pulp, which at this stage of growth forms the greater part of the contents of the crypt, and upon which the enamel and dentinal cap already formed is resting.

In such instances the tissues will not be in their normal state, and will be predisposed to inflammatory conditions. The tooth pulp will be especially irritable, and will respond to comparatively feeble impressions.

FIG. 16.



NORMAL APPEARANCE OF THE LOWER JAW AT THE PERIOD OF THE BEGINNING OF THE ERUPTION OF THE DECIDUOUS TEETH, SHOWING THE DISTENTION OF THE BONY WALLS AND THE NATURAL APERTURES IN THE JAW THROUGH WHICH THE TEETH ARE THRUST. ALVEOLAR PROCESS NOT YET FORMED: RAMI NOT FULLY DEVELOPED. (Tomes.)

The pressure that may be exerted upon the susceptible pulp in such instances may cause serious complications, but these will necessarily be of a reflex nervous character. The irritation to the delicate pulp tissue will react upon other tissues, through their nerve connections, and various functions may be disturbed. A diarrhea may possibly be the consequence, but it will not resemble that produced by digestive disorders. The child will plainly show nervous irritation; it will suddenly wake from sleep, perhaps with a scream. There will be spasms of the facial muscles, and intervals of pain will be succeeded by entire relief. There will be alternate slavering and dryness of the oral cavity. If a diarrhea is at times present, it will probably be succeeded by constipation. The appetite will be exceedingly variable, and there will be present that peculiarly fretful condition that indicates nervous irritability. It will be afraid to bite upon anything whatever, and

will strenuously resist all attempts to touch the gums. This will be in marked contrast to the condition when, despite digestive disturbances, dentition is proceeding normally. The child then delights to bite upon some yielding substance, like the finger or a rubber ring. If now the mouth is examined the gums about the advancing tooth will probably be found swollen, red, and turgid, and exceedingly tender to the touch. The mucous membrane will have lost the pink, tense, and glistening appearance of health, and will plainly show its disturbed state. During examination the child will perhaps scream hysterically, and plainly indicate its exalted nervous excitement.

When these symptoms and appearances are present, no time should be lost in extending surgical aid. In view of the considerations advanced in Chapter XVI, and the possibility of the more serious complications which may arise from reflex nervous disturbances of dental origin, the occurrence of these indications should be looked upon as of the gravest character, and the most exhaustive examination of the dental condition should be instituted. The general state of advancement of the teeth, in comparison especially with the development of other organs, should be at once heedfully observed, and if any tooth is probably, or even possibly, due its condition should be accurately ascertained. Full and free lancing of the gums has so often brought relief as by magic that it should be resorted to even when not positively indicated. The mere wound, with the local loss of a small quantity of blood, has been known to bring instant relief when the most drastic medical remedies have entirely failed.

Prompt and deep scarification over any advancing tooth should be made, to divide the swollen gums and disengage the tooth. A crucial incision is usually best, if it be a molar, while a longitudinal one may answer for an incisor. In either case it should be deep enough thoroughly to divide all the tissues over the tooth, and extensive enough to free it. If there is any overlapping operculum of bone, this should be divided, for it will be the greatest obstacle in the way of the tooth eruption.

This will usually be sufficient to give immediate and entire relief. If the diagnosis of the condition was correct, and the incisions sufficient to disengage the whole tooth, the change that ensues will sometimes be fairly startling. It may be well to give

a small dose of potassium bromide (two to five grains), or an enema of chloral hydrate (five to ten grains), in water, to quiet the nervous excitement and induce sleep, but usually this will not be found necessary, the removal of the cause of irritation being sufficient. There may occur instances in which the child is in spasms, or in convulsions, and the administration of chloroform necessary for their control before surgical measures can be safely resorted to, in which case there should be no hesitation on the part of the operator.

The instrument best adapted to the division of the tissues over advancing teeth is the curved and pointed bistoury. It would be difficult to devise a worse one than the ordinary double-edged ovoid lancet, which cannot be made to cut at its extreme point. Something that can, if necessary, be forced deep down into the tissues at its point, and then drawn toward the operator, is essential. A pushing force should never be resorted to, as control of the instrument cannot be maintained, and there is serious danger of wounding surrounding tissues by its employment.

CHAPTER XXI.

DENTAL CARIES.

A POPULAR impression has long existed that caries of the teeth is of modern origin, and that it is due to an artificial mode of life, to a departure from the laws of nature, and to factitious environments. It has been held that our early progenitors knew not the pains of toothache, and retained their dental organs to a late period of life. The application to these fanciful speculations of the facts evolved by actual observation has shown that this is an error, and that there is not now and there never has been a pathological condition so universal throughout animal life as is caries of the teeth, for it is by no means confined to man. There are few of our domestic animals in whose mouths careful examination will not reveal some form of oral disease, and among them caries plays an important *rôle*. Nor is it confined to domestic animals; the author has in his possession many skulls illustrating

FIG. 17.

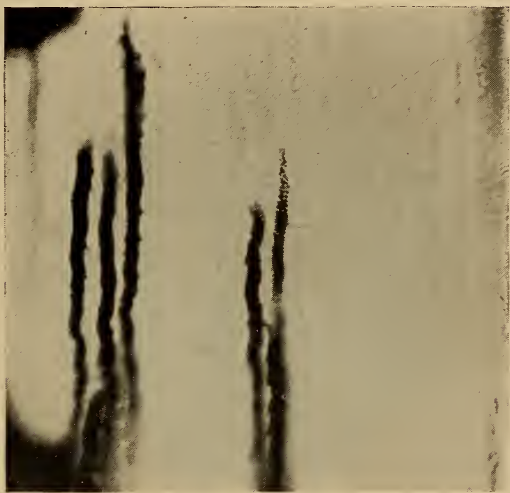
CARIES IN THE LOWER ANIMALS. TEETH OF A BABOON (Cynocephalus) FROM A SKULL IN THE POSSESSION OF THE AUTHOR.

Unfortunately the cut shows but a small portion of the decay. There were but three sound teeth (lower incisors) in the whole denture.

this, among them being that of an old male gorilla, with extensive decay of the teeth, and also connecting alveolar and antral abscesses, with necrosis of the superior maxilla.

No people have yet been found among either civilized or savage races in which dental caries was not prevalent. Even the most ancient had no immunity, and the skulls of Egyptian mummies, four thousand years old, exhibit the same decay that is

Fig. 18.



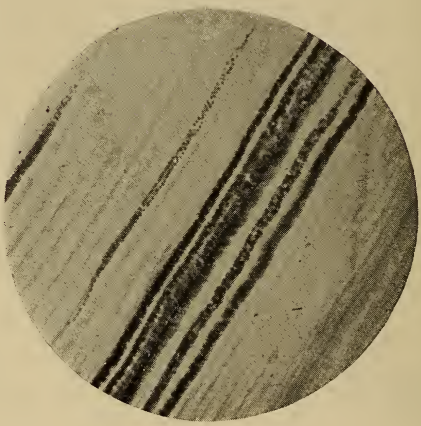
Dental Caries. Penetration of the Tubuli by Micro-Organisms. (Miller.)
Early stage shown by differential staining, only the organisms themselves being apparent. Very highly magnified.

observable to-day. Hence we are not dealing with a condition that depends upon recent degeneration when we attempt the consideration of the subject. It is as old as the human race, and has probably caused more of pain and distress to the human family than any other disease with which man is afflicted.

It would naturally be expected that a condition so universal, so ancient in its origin, and so distressing in its results would have been carefully studied, and long since thoroughly comprehended. The fact really is, that until within fifteen years almost

nothing was known of the real etiology of caries, or of the changes it involved. Speculation there had been in abundance, and many ingenious theories had been evolved, none of which satisfied the existing conditions. It is within the memory of even comparatively young practitioners, when at our dental associations and meetings the most contradictory hypotheses were advanced. It was declared to be the effect of an inflammatory process of the tooth tissues. It was attributed to mineral acids that dissolved out the calcic salts of the teeth. It was by some believed to be due to a perverted nutrition, whereby there was a breaking down

Fig. 19.



Dental Caries. Penetration of the Tubuli by Micro-organisms. (Mummery.)

instead of a building up of tooth elements. It was claimed to be the effect of a lack of mineral elements in the food during the period of growth. It was urged that it is the effect of electrolytic currents generated in the mouth of sufficient electrical energy to decompose tooth substance. In fact, the etiology of caries was a common battle-ground on which the advocates of the different theories met for polemical disputation without the possibility of victory for either combatant through the positive establishment of any special hypothesis.

With the comprehension of the true principles of fermentation and the advance of bacteriological knowledge, light began to dawn on the dark places, until at last, by the exhaustive

researches of Prof. Dr. W. D. Miller, an American dentist resident in Berlin, the problem of the ages was finally solved, and the true nature of dental caries was determined. It was found that those who had described it as a decalcification through the action of an acid were partially correct, but greatly mistaken as to the source of the acid. The advocates of the vital hypothesis had a section of the truth, but not enough upon which to base a practice. Electrical action had nothing whatever to do with it.

Miller demonstrated that dental caries is due to a number of factors, but the principal and basal one is the growth of oral bacteria.

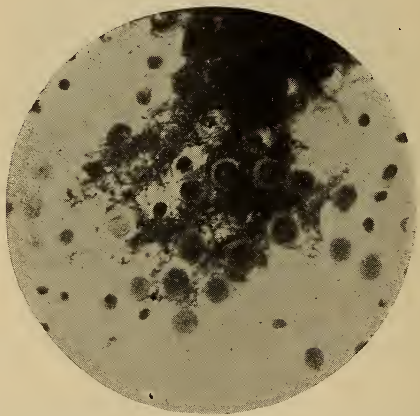
FIG. 20.

DENTAL CARIES. ENLARGEMENT OF THE TUBULI BY THE ACTION OF BACTERIA. (Miller.)

It has been shown in a previous chapter that the mouth is especially adapted to the growth of micro-organisms. Here are found the proper temperature, the most fitting media, and the required moisture; the temperature is as evenly maintained as it can be in any incubator, while the proper soil for their proliferation is always provided. The various foods, especially the starches, will by the action of the ferments of the mouth be changed into forms admirably adapted to the growth of the acid-forming bacteria. Of some of these Miller made cultivations, analyzing their by-products, and he found, as the result of the proliferation of some special organisms, lactic acid. Further observation enabled him specifically to point out the exact method by which caries is produced, which is as follows:

In the sulcus of a tooth, or between two teeth, or in any pit or irregularity of its surface, food lodges. By the action of some ferment this is perhaps changed into a fermentable sugar. This forms a suitable medium for some of the bacteria, and it is perhaps at once infected with certain acid-producing fungi, which in their growth split up the fermentable sugar, building into their own substance such elements as are necessary, and leaving the remainder to form new combinations, or by-products, one of which may be lactic acid. This acid, especially active in its nascent or formative condition, attacks the teeth, dissolving out the calcic salts, and forming a depression in which more food lodges, to pass through the same changes and to be in turn decomposed by new colonies of bacteria, thus forming more acid to continue the destructive work.

FIG. 21.



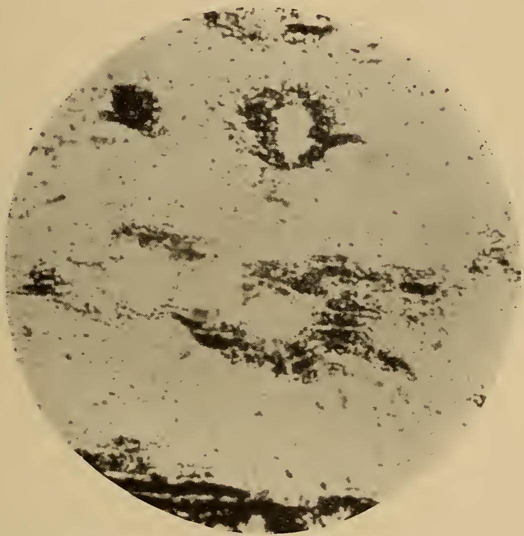
DENTAL CARIES. CROSS-SECTION SHOWING MELTING DOWN OF THE INTERTUBULAR SUBSTANCE AND THE FORMATION OF MINUTE CAVITIES THROUGH THE ACTION OF MICRO-ORGANISMS. (Mummery.)

The dissolving out of the calcareous parts of the tooth leaves behind the organic or living portion, which may pass through inflammatory or degenerative stages, finally to be destroyed by putrefactive organisms. This is the essential principle of Miller's discovery. The enamel once penetrated by the products of the growth of the vegetable fungus, the progress of the disorganization is more rapid.

The bacteria penetrate the dentinal tubuli (see Figs. 18 and 19); the acid generated within them, through the action of the

micro-organisms, enlarges the tubules (see Figs. 20 and 21), melting down two or more into one, thus forming minute chambers or cavities in the dentine (see Fig. 22), which ultimately are blended into a yet larger one, and thus decay proceeds. Microscopical examination shows these small spaces to exist at a considerable distance beyond that which is actually broken down, and to account for the friable, crumbling dentine beyond the margin of the cavity proper.

FIG. 22.



DENTAL CARIES. THE FORMATION OF MINUTE CAVITIES THROUGH THE MELTING DOWN OR LIQUEFACTION OF THE INTERTUBULAR SUBSTANCE. (Miller.)

The area denominated by Miller "the zone of infected dentine" is that pervaded by the organism, but in which the dissolving out of the calcareous inorganic matter of the tooth has not yet fairly commenced.

Yet farther into the structure of the tooth have penetrated the bacteria, filling the tubuli without having distended them. Not infrequently a number of these distinct zones of infection or caries are seen in their different stages, and readily traced. They are all the result of tooth infection and tooth decalcification through the action of bacteria.

Miller, having demonstrated the true nature of this disease

by analytical methods, next attempted a kind of synthesis, arriving at the same result, thus by an independent process proving the correctness of his previous observations. Obtaining a pure culture of a bacillus of decay, he immersed an extracted tooth in a proper culture solution, and with the utmost solicitude keeping it in the proper condition and at the exact temperature, he infected it with the bacillus and produced true caries outside the mouth and so removed from all physiological or vital connections. He thus demonstrated that caries is not a vital process, and that the proliferation of the bacillus under proper conditions will produce it as readily outside the body as in it (see Fig. 23).

It must, then, be accepted as finally proven that dental caries is the result of an infection, and a true germ-produced disease. It is essentially a septic condition, and its medicinal treatment must be antiseptic. All prophylaxis must be in this direction, and the general principles of Listerism are as applicable to caries as to the treatment of wounds. To proceed farther than this in the consideration of the etiology of dental caries would be outside the scope of this work.

CHAPTER XXII.

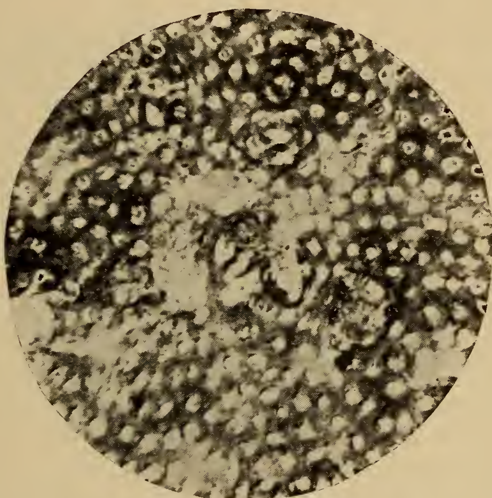
THE PATHOLOGY OF DENTAL CARIES.

Physiologists, pathologists, and histologists are sometimes inclined to consider the teeth as organs isolated, dissociated from the rest of the body, and as of such dissimilar, diverse characteristics that their relation to other tissues is but a minor factor in their study. Dental practice has been too exclusively confined to the teeth themselves, reputable practitioners asserting openly that there is no need for the dentist to study general anatomy or physiology, and protesting against everything save the very narrowest and most restricted teaching in our colleges. Almost unconsciously the great body of practitioners have been led to think of the teeth as segregate organs. There are many of our number who, while claiming professional relationship, treat their vocation as exclusively mechanical, and unwittingly debase their own condition to that of a mere artisan.

The teeth are true modifications of bone. The study of comparative dental anatomy teaches through what gradations they

have passed in their evolution; very many of the intermediate steps are recorded in the oral or pharyngeal cavities, and even in the gastric regions, of animals now extant. In some instances mastication is absolutely performed upon true bone, of modified structure, which, however, is soon lost if it is submitted to any rough usage. We sometimes marvel that the teeth decay as they do. Were they not markedly differentiated in structure from the bone of which they are only modifications, they would not last as long as they do.

FIG. 23.



ARTIFICIAL CARIES. CROSS-SECTION. IDENTICAL WITH NATURAL CARIES. (Miller.)

That the teeth are living organs, with a vital dependence upon other tissues, that they are intimately connected with the rest of the body, is readily indicated by the fact that they are nourished by the same blood supply and receive their innervation from the same nervous system with the other organs. It is true that they are the hardest, densest tissues of the body, but in this they differ comparatively little from true bone. They are made up of a living matrix, into which calcium salts have been incorporated to give to them consistence. They are developed from the same connective tissue elements with other analogous tissues. Componently they only differ from bone in having a little more of the calcic salts and a little less of the living matter, in this respect the several tissues of the teeth showing the same variations that are

observable in different kinds of bone. To illustrate this the following table is presented:

	Bone.	Cementum.	Dentine.	Enamel.
Animal matter	34.00	32.00	28.00	3.00
Earthy matter	66.00	68.00	72.00	97.00
	100.00	100.00	100.00	100.00
Calcium phosphate	51.04	56.73	62.00	85.00
Calcium carbonate	11.30	7.22	5.50	8.00
Calcium fluorid	2.00	1.63	2.00	3.20
Magnesium phosphate	1.16	0.99	1.00	1.50
Sodium salts	1.20	0.82	1.50	1.00

This table gives but an average of the proportional constituents of the tissues. It would be well if a careful study of it could be made by every dentist. It will be seen that the same elements enter into the composition of all the hard tissues.

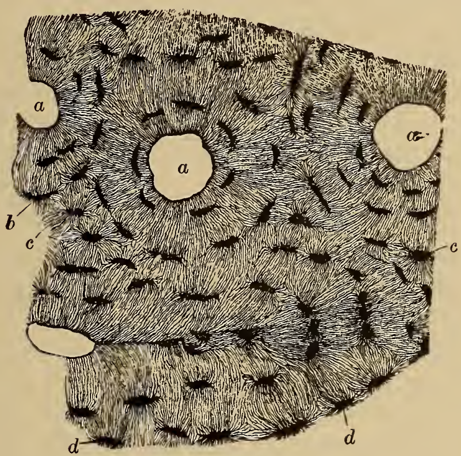
The essential variation of tooth tissue from true bone is that through the progressive modifications of cementum, dentine, and enamel there is a gradual loss in the proportion of animal or organic matter, and a proportionate increase in the earthy or inorganic. This is most manifest in the calcium phosphate, upon which the teeth mainly depend for their density and hardness; there is comparatively little variation in the relative amounts of calcium carbonate, magnesium phosphate, and the other salts. In bone the living matter is more than half as much as the inorganic, while in enamel it is but one-thirtieth.

But it is not alone in its constituent elements that the modifications of tooth from bone are exemplified. In their physical structure the gradation is still more marked. In bone the most distinguishing feature of the nutritive apparatus is the Haversian canals, about which are arranged in concentric grouping the cells containing the living matter. These corpuscles, the lacunæ, communicate with each other and with their source of nutrition by minute canals, the canaliculi. Each regular arrangement or system of these communicating lacunæ is called a lamella, and the nutritive currents are thus in relation with all the tissue cells through the canaliculi. (See Fig. 24.)

The first modification, or differentiation, is found in the cementum, which has all the distinguishing features of bone, if we except alone the lamellæ. The lacunæ are present, and the canaliculi; even the Haversian canals are sometimes found. They are

not as constant as in true bone, but even in that they are not always present. The lamellar, concentric arrangement of the lacunæ about the Haversian canals is alone lacking, and this is the case even when these vascular canals are found in the cementum. The proportion of animal and earthy matter has been but slightly changed, the variation between different bones being sometimes greater than that between bone and cementum. Cementum, then, essentially differs from bone only in the loss of the lamellar arrangement of the cells. (See Fig. 8.)

FIG. 24.



TRANSVERSE SECTION OF BONE, SHOWING LAMELLAR ARRANGEMENT OF THE LACUNÆ ABOUT THE NUTRITIONAL CENTERS.

a, Haversian canals. *b*, *c*, *d*, Lacunæ with branching canaliculi. (Gray.)

The next step in the differentiation is found in the dentine, which has lost the lacunal corpuscles that distinguish cementum and bone. As these contain the greater proportion of the living matter, we naturally anticipate a considerable reduction in that element, and analyses show that it has but about four-fifths the amount found in bone, while the earthy salts are correspondingly increased. In its physical structure, then, dentine retains but the canaliculi of bone, and these appear in their analogues, the dentinal fibrillæ. Instead of being the channel of communication between the lacunæ, as in bone and cementum, they serve to connect the pulp, the analogue of the medulla of bone, with the cementum and dentine, the dependence not being very apparent. As in bone and

cementum, they are the medium of nutrition to the interstitial parts and the parenchyma. Dentine, then, is bone modified in structure by the disappearance of the lacunæ, as well as their arrangement into lamellæ. (See Fig. 9.)

Finally, enamel is developed,—the densest, hardest, heaviest tissue of the body. This is that which alone is exposed to attrition, and to the direct action of foreign substances.

Bone, cementum, and dentine are normally protected from exposure. If the former is uncovered, even to the external air, the most serious consequences may follow. Cementum is a little, and dentine considerably more tolerant of submission to external influences. But neither of them accepts it without a pathological protest. Enamel alone successfully withstands external contact, and even that is in better condition when in possession of its natural covering, cognate to the skin and mucous membrane, Nasmyth's membrane.

The very circumstances under which enamel exists must demand a material modification of structure. Accordingly we find that not only the lacunæ of bone and cementum are lost, but the canaliculi of bone, cementum, and dentine have disappeared, and the principal remnant of the living matter left is the microscopical septum between the enamel prisms. (See Fig. 10.) But it is not dead, inert matter. Three per cent. of its structure is animal, so that, tenuous as is the thread, it has yet a vital connection with the other living portions of the body. The necessities of its existence demand that it shall have but a very minute proportion of animal matter to protect it against the exposure and rough usage which it must receive, but still it is identical with bone in its constituent elements, though widely variant in their relative proportions.

Enamel is bone deprived of the lacunæ and canaliculi, cut off from its genetic organ, without independent nutrition, but still retaining a proportion of that animal matter without which it would be something alien and foreign.

It is from this standpoint that the tissues of the teeth are properly considered. It is in their relation to other tissues, and as a part of the living organism, that they are to be studied. The teeth are not lifeless, passive, extraneous objects. They have their pathological degenerations that demand medicinal agents. Their treatment cannot properly be exclusively surgical or op-

erative. It is true that their nutrition is limited and sluggish, but it exists, and must be considered. They are amenable to the same general laws with the rest of the body. They contain a large proportion of inorganic matter, but even that must be elaborated in the alembic of nature,—it cannot be taken ready-made; the calcium phosphate that forms so great a part of their body is of organic origin, and was distilled by nature's process from the organic matter that alone can be used as food or built into the system.

Every tissue of the tooth, as is the case with all other tissues, is the product of growth, hence is truly organic, and the assimilative processes can no more accept for nutritive purposes such inorganic matter as crude calcium phosphate than it can utilize carpet tacks to give iron to the blood, or lucifer matches to furnish phosphorus for the brain. Such preparations may act as medicines, to be excreted as received, but their administration for metabolic purposes is an utter absurdity.

That an hereditary tendency may be a factor in the etiology of dental caries, no one will for a moment dispute. One may inherit a diathesis, a congenital atonicity or a lack of resistant power, but a bacillus is not received as a patrimony. Modern investigation proves that so many of our disorders are of infectious origin that the doctrine of heredity must be materially modified. It has been demonstrated by repeated experiment that there is less of difference in the structure of so-called good and bad teeth than has been usually imagined. This throws us more directly back upon the *vis medicatrix naturæ* for our cures, and places us in a more intimate relation than ever with the vital principle, the innate resistant power of the body, and directs our thoughts into new channels. Dental caries must be studied from the vital standpoint, and in this view we approach the subject.

CHAPTER XXIII.

THE MEDICINAL TREATMENT OF DENTAL CARIES.

It having been demonstrated that caries of the teeth is chiefly due to the action of micro-organisms, it naturally follows that the remedies employed, aside from operative ones,—which it is not the

province of this work to consider,—must be mainly antiseptic. Were it possible completely to sterilize, and to keep sterilized, the oral cavity, there could be no decay. But this is impracticable, and even undesirable. The peptonizing action of many of the bacteria may be an important factor in digestion, hence it would not be wise, even if it were possible, to eliminate them. But of the advisability of at least limiting their action there can be no question. The putrefactive organisms certainly can have no useful office in the mouth, and common cleanliness demands that their growth should, as far as possible, be prevented.

Could the teeth and the oral tissues be kept entirely clean and free from food and other *débris,* caries would be so limited that it would be of little moment. A carefully polished surface does not retain detritus or *débris.* Unless there are depressions, or pits, or roughness, there is nothing to which particles of food can cling. It is evident, then, that the first prophylactic measure against caries is the careful polishing of the teeth. Every deposit upon them must be removed, every pit obliterated, and every rough surface made entirely smooth. This will be the work of the dentist, but the keeping of them in that state will depend upon the exertions of the individual himself. A set of natural teeth in a state of perfect cleanliness is a sight seldom vouchsafed to anyone. Quite as rare would be a patient, just from the chair of the dentist, whose oral cavity had been put in perfect order. The average practitioner neither recognizes nor attempts the cure of half the pathological conditions that exist in the mouths that he treats. He fills the most conspicuous cavities, removes deposits that actually obtrude themselves upon his notice, and ignores the rest. Nor is it necessarily his own fault in every instance, for patients sometimes might offer serious objections to expending the time and money necessary for the treatment of all diseased conditions and the putting of the mouth in complete order.

There is, however, no excuse for failing to call the attention of decently clean people to minute sedimentary precipitations upon the teeth, depressions or erosions of their surfaces, and inflammations and irritations of the soft tissues about them. That which is neglected is mainly in the line of prophylactic treatment. Were dentists generally more faithful to duty, their practice would be widely extended, while the people would be greatly benefited.

It is unnecessary to call the attention of the student or practitioner to the most approved methods of cleaning the teeth. That duty devolves upon the teachers of operative measures. But the proper medicinal agents may be adverted to, and their use recommended. In the performance of this task it is impossible entirely to forbear mention of proprietary remedies, whose employment, when others can be substituted for them, should be avoided; yet they are sometimes a convenience, and, when the formula is a public one, may be professionally prescribed. A convenient, effective and unobjectionable antiseptic mouth-wash, consisting of a single simple remedy, is quite unknown. The most efficient germicides possess toxic or caustic properties that are sufficient to exclude them. The best antiseptics are liable to the same objections, and we are thus forced back upon the essential oils, which must be combined with other things to make them most useful. Listerine, borine, borolyptol, and other combinations are proprietary preparations, and therefore objectionable on ethical grounds, for no physician has any right to make a prescription for a patient unless he is fully aware of its entire character and thoroughly conversant with every drug in it. He is paid for the expert knowledge of which the patient is not possessed, and he betrays that patient's professional confidence if he does not exercise due intelligence. Hence proprietary and secret remedies have no place in this work, unless their complete working formulæ shall have been submitted to and approved by the author.

For antiseptic use in the mouth, lysol presents some advantages, and the following may be used with the tooth-brush:

℞—Lysol,	℥ss;
Aquæ,	℥xvj.

Carbolic acid is not palatable, and it possesses toxic properties that forbid its use in strong solutions. But it is excellent as an antiseptic, and the following formula may be found useful:

℞—Carbolic acid crystals,
Glycerol,
Rose water, of each 2 ounces.

Five to ten drops in a wineglass of water should be used as a gargle, or with the brush.

Thymol is similar in its action to carbolic acid, while it is free from its disagreeable odor:

℞—Thymol,	4 grains;	
Benzoic acid,	45	"
Eucalyptol,	180	"
Water,	2 quarts.	

This should be used as a gargle, after cleaning the teeth.

The following is recommended by Professor Miller as an antiseptic gargle and wash:

℞—Thymol,	4 grains;	
Benzoic acid,	45	"
Eucalyptol,	3½ drams;	
Alcohol,	25	"
Oil of wintergreen,	25 drops.	

Hydronaphthol has been employed as an antiseptic, but was formerly more used than it is at present. The following formula has been recommended for a mouth-wash:

℞—Hydronaphthol,	ʒij;
Tinct. calendulæ,	ʒiv;
Aquæ dest.,	ad ℥viij.

Any of these may be used with the tooth-brush, or as a gargle after cleaning the teeth.

CHAPTER XXIV.

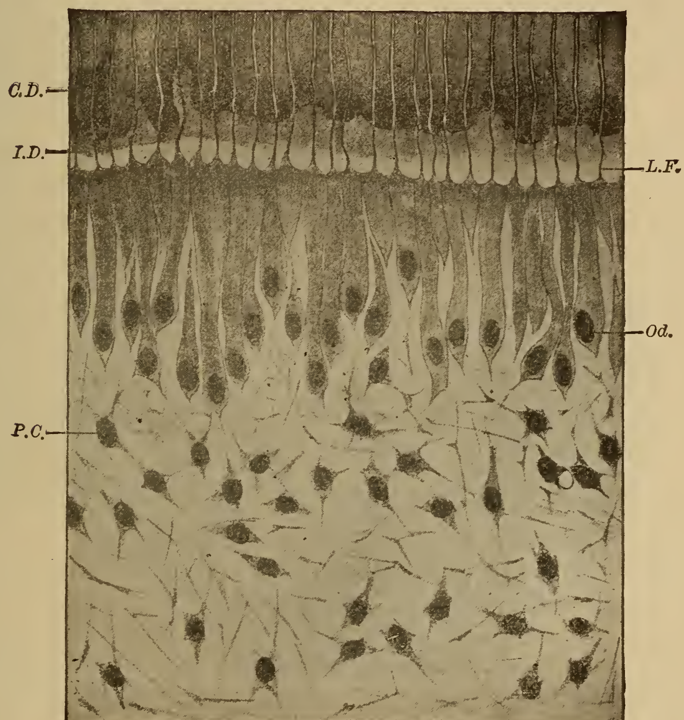
PULPITIS—INFLAMMATION OF THE DENTAL PULP.

Save as it is modified by surrounding conditions, inflammation of the pulp does not differ from that of other analogous tissues. The initial processes are the same, and hence the remarks in the section on Inflammation are applicable to the condition now under consideration. When the subject of general inflammation is fully comprehended, then, and then only, can the phenomena presented in pulpitis be clearly understood. It is but necessary to consider the peculiar complications brought about by the environments of the dental pulp, and to make due allowance for them, when the whole matter becomes plain and lucid. These complexities arise from the fact that the tissue of the pulp is somewhat modified in structure, and at the same time is enclosed within unyielding, osseous walls, which in health form its sure protection and in disease its rigorous prison-house.

Whether or not the dental pulp, in its healthy, normal condition, is or is not sensitive to external impressions is a disputed

question which cannot be satisfactorily answered, because if it is responsive it is at once claimed that it is not in a normal condition. Certain it is that an entirely healthy tooth gives no sentient signs of the presence of a living pulp. It is sometimes a difficult matter positively to diagnose a dead pulp from a healthy living

FIG. 25.



ILLUSTRATING THE RELATIONS OF THE PULP TO THE DENTINE.

C.D. Formed, calcified dentine. *I.D.* Forming, uncalcified dentine. *L.F.* Dentinal fibrillæ, fibers of Tomes,—processes from the odontoblasts. *O.d.* Odontoblast cells. *P.C.* Cells of the tooth pulp. (Burchard, after Röse and Gysi.)

one in natural conditions. Both are equally unresponsive to ordinary thermal changes, and the enamel and dentine of each are equally insensitive.

Those who have had occasion to drill into or excavate a tooth that is entirely without disturbance of the pulp tissue, know that the dentine is unresponsive, while the pulp may be, and often is, punctured without the knowledge of the patient.

But if the tooth shall have sustained an injury, if there is recession at the gums, or if there shall have been any pain in the teeth whatever, indicating pulp complications, or even any pulp disturbance insufficient to produce pain, both dentine and pulp may be exquisitely sensitive. There are occasional instances in which caries has extended to the pulp tissue, but in which there never has been either pain or sensitiveness. This cannot be reasonably accounted for upon the theory of personal idiosyncrasy, for individual temperament will scarcely cover a departure from general physiological laws. There must be a good and sufficient reason for such an immunity.

The bloodvessels of the pulp possess a modified structure, in that they are without the complete muscular coats of those found in most parts of the body. (See Fig. 7.) In this respect they resemble those of the brain, which also is a tissue protected by unyielding, bony walls, analogous to those of the tooth. The nerves of the dental pulp are also modified, for while they are composed of nervous elements they lack the general structure of those of most other parts of the body, and they are without the usual sheaths. The connective tissue of the pulp is not especially modified in structure, but it must be peculiarly so in function, through its exceptional blood and nerve supply. These variations will be specially considered in the chapter devoted to the diseases of the pericementum.

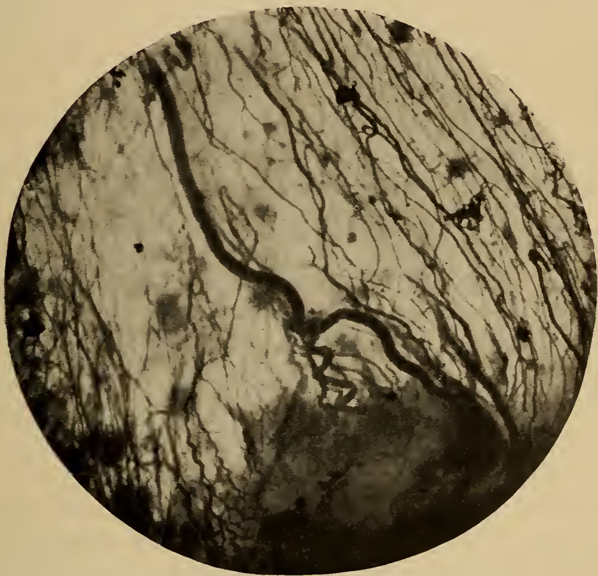
The dentine is without nerve supply, and yet when in an irritable condition it becomes acutely responsive. Sensation can only be conveyed through the dental fibrillæ, whose embryonal structure, containing all the elements of nerve tissue, becomes inordinately responsive in certain conditions. It is well established that formative tissue, embryonic matter, may take on inflammatory conditions, and under such circumstances possess characteristics unknown to it when in a normal state.

It might be reasonably inferred, then, that the sensitiveness of either dentine or tooth pulp may be the direct result of irritation, and the inceptive stage of an inflammatory process; that sensitiveness of dentine is but the result of that abnormal, irritative, inflamed condition; that the peculiar phenomena presented are due to the modified blood and nerve supply, and that in its normal and healthy state it may be quite irresponsive to external impressions;

that any special responsiveness of either of the tooth tissues to external impressions is an indication of a pathological condition, and that in treatment this should always be kept in view.

The pathological changes presented and the phenomena exhibited in inflammation of the tooth pulp will differ from the corresponding phenomena in most other tissues just so far as the structure of these latter is varied and their environments are modified by the tissues with which they are in relation. The peculiari-

FIG. 26.



CONGESTION OF THE BLOODVESSELS OF THE TOOTH PULP OF A DOG AFTER THE APPLICATION OF ARSENOUS ACID.

ties of the nerve supply will change the character of sensation, while the special vascular system will cause a variation in the phenomena presented in the earlier stages of inflammation, and materially modify diapedesis. Proceeding upon this hypothesis, it is not difficult to comprehend some things heretofore unintelligible in the pathology of the dental pulp, and to find indications that may be a more complete guide in diagnosis and treatment.

A specially sensitive tooth is one whose tissues are in an irritable condition, and this is either the initial step in, or a

positive stage of, an active inflammation. The irritant may be any one of a long list, and may have its origin either in some organic change, in a mechanical injury, or in some pathological or diseased condition. Thus:

1. Caries has perhaps invaded the tooth, and micro-organisms have penetrated the tubuli, becoming themselves the irritant, or exposing the deeper dentine and pulp to the irritating action and thermal changes of external agents.

2. It may be that an inserted filling is this outward irritant.

3. There may be recession of the protecting gum tissue at the cervical portion of the tooth.

4. A traumatic injury, a blow, inordinate use, the attrition of mastication, or any mechanical violence may be the source.

5. Structural changes within the tooth pulp, such as the formation of calcific deposits, are a sufficient excitant.

Whatever the possible cause, there will be a hyperemia or determination of blood to the irritated pulp tissue and an engorgement of its capillaries. Because of the absence of the usual arterial and venous coats, the blood channels at once yield to the pressure. There is not the normal vaso-motor system of nerves to control the resilience of the vascular system, and diapedesis, or the escape of the elements of the blood into the pulp tissue, is materially modified. It may not at once take place in the usual acceptance of the term, but a stage of active engorgement of the blood channels ensues. (See Fig. 26.)

The dental pulp is without the full and complete chain of lymphatics of the absorbent system, because the modification of the blood supply in a measure makes it unnecessary. The comparatively unrestrained yielding of the blood channels, and the retardation of the infiltration of the pulp tissue, allow for a return to a physiological state, if once the irritation ceases, without the necessity for the usual process of resolution through the activity of the lymphatics in relieving a hyperplastic condition. It follows, then, that the treatment of ordinary pulpitis, after the removal of the irritating cause, should be directed toward the relief of the congested condition, by deflecting in some manner the determining blood current and allowing the engorged vessels to empty themselves. So long as the possibility for this exists, it is quite feasible to preserve the vitality of an inflamed pulp.

When the pathological condition shall have proceeded to the extravasation into the body of the tissue of inflammatory products, there are practically no lymphatics to take them up, and their removal is as impossible as is that of any great effusion in the brain. Pulp capping under such circumstances will be a hopeless proceeding, and the presence of any infiltrated or effused matter will contra-indicate it. The fact that some pulps become fully exposed and their investing tooth walls are broken down without either pain or special sensitiveness, may be accounted for through their never taking upon themselves real inflammatory conditions, because of a modification of nerve structure greater than that which is usual.

CHAPTER XXV.

TREATMENT OF INFLAMMATORY CONDITIONS OF THE DENTAL PULP.

Usually, the first indication of irritation of the dental pulp is responsiveness to external impressions, manifested by a sensitiveness to thermal changes. Cold air or cold water cause pain of a sharp, lancinating character. Not infrequently the neck of the tooth, or any abraded surface, is also sensitive to an outward irritant, such as a metal tooth-pick or instrument. This indicates dentinal irritation. The responsiveness to thermal changes increases and becomes more persistent, until there is a distinct odontalgia or toothache. This pain will be rather paroxysmal, returning upon slight provocation and passing away in a few moments. It may be difficult for the patient to determine exactly which tooth is affected, because of its sympathetic nature and because it is distributed over a considerable territory. Successively isolating each tooth by the rubber-dam, and the application of alternate heat and cold, will, however, usually determine the matter. Sometimes there is a response to percussion, and a diagnosis may thus be reached. This earlier stage will be that of hyperemia, and the beginning of engorgement, or congestion. The exalted sensibility is due to the irritable condition of the nerve tissue. If relief is not obtained, the pain, with the exacerbation of the inflammatory condition, becomes more intense and continuous. With the increased engorgement, the pulp, which is

held immovably within the bony tooth walls, becomes intensely irritable, and the pain instead of continuing remittent becomes almost continuous. The lancinating flashes can no longer be distinguished, but are so quick in succession as to be practically unintermittent, and there is at the same time a deep, boring pressure felt, which indicates that the inflammation is passing or already has passed to its second stage, that of effusion, in which there is an oozing out of the elements of the blood into the tissues.

Up to this point the vitality of the pulp may readily be preserved, if active measures are taken for the relief of the inflammatory condition. This stage once passed, and extravasation into the pulp tissue having taken place, the probabilities are largely against conservation.

About this time the pain changes in character somewhat, and it is not of such a sharp, lancinating nature. It becomes more steady and less paroxysmal. There is a greater feeling of pressure, and it is more readily located. The pulsation, which up to this time is very distinct, now ceases. The congestion soon reaches its height, and entire stasis of the blood current in the pulp is imminent. Cold is no longer irritative and warmth grateful. The opposite condition ensues, and ice-water will relieve the pain, while any warm application exacerbates it. The suffering caused by the affected organ is intense, but the end is probably near at hand. With complete stasis sensation is gradually lost, the pain progressively abates, neither cold nor heat aggravates, and the tooth is irresponsive to any ordinary irritant. The inflammatory process has run its destructive course, and the pulp is dead. This is the usual train of symptoms and the ordinary progress of the disease.

The treatment in the earlier stages should be abortive. Every effort should be put forth to relieve the hyperemic condition and to restore a normal circulation. The first essential is to make a clear diagnosis of the case, by carefully considering all the symptoms. The exact stage of the disease should be determined if possible. This having been done, the next point will be to remove the cause. If it is progressive caries, the cavity of decay should be carefully washed out, all *débris* removed, and an anodyne introduced. If any foreign substance is the irritant, it must at once be eliminated. The tooth must be relieved of all labor of mastication and given entire rest. Counter-irritants, such as iodine and aconite, or capsi-

cum bags and plasters, are useful by promoting metastasis; that is, a new focus of inflammation is created in an approximate territory, but which is upon the surface where it can be reached and where resolution may be anticipated. This has a tendency to divert the impending blood currents, and thus to relieve the threatened engorgement of the pulp.

Hot pediluvia, or foot-baths, should be prescribed, preferably to be used at night before retiring. The water must be as hot as can well be borne, and these are to be continued for at least thirty minutes, for the purpose of equalizing the circulation and relieving the plethoric condition of the pulp.

Saline cathartics are useful and may frequently be employed with good results. They reduce the blood tension, remove from the sanguinary fluid a portion of its watery constituent, and thus greatly diminish the stress.

Diaphoretics are perhaps the most important of the general remedies. They not only extract a considerable amount of water from the system and from the blood current, but they act as general depurators, promoting healthy functional action and removing local obstructions.

Anodynes are indicated and should especially be administered to nervous or irritable patients. They equalize nervous function and tend to restore the proper tone to the arteries and veins through the vaso-motor system, and to allay the general nervous excitability.

Probably there never was a case of simple pulpitis that would not yield, temporarily at least, to the vesicant action of a powerful counter-irritant at the back of the neck, a foot-bath continued for thirty minutes, and twenty to forty grains of potassium bromide. Such drastic measures, however, are not often called for, and are inadvisable when milder means will suffice.

Any of the preceding measures may be resorted to in cases in which there is no actual or threatened exposure of the pulp through progressive caries, or by accident. When there is a large cavity of decay, it must first of all be thoroughly opened up, and all *débris* and foreign substances removed as carefully and as completely as possible. It should next be washed out with tepid water in which a little salt has been dissolved, by gently injecting the stream from a mouth syringe. The cavity should be dried out, and a pledget of cotton dipped in oil of cloves, or dilute creosote,

or hamamelis inserted, this to be carefully sealed up without pressure, by means of gutta-percha or a pledget of cotton dipped in chloro-percha. A solution of sandarac in which to dip the cotton should not be employed, because it insecurely seals it and very soon decomposes, leaving the cavity in a worse state than at first. It is also likely to encapsule the remedy, and thus to isolate it and preclude its action.

If there is actual exposure of the pulp tissue, after the cavity of decay has been opened up and carefully cleaned and washed out, the rubber-dam should be applied, the opening dried out by means of hot air, and the pulp and cavity walls sterilized by the application of mercuric chloride, solution 1 to 2000, or some other effective germicide. If there is considerable congestion, a pledget of cotton dipped in the following may be carefully placed over the point of exposure and sealed up:

℞—Plumbi acetatis,	gr. v;
Tinct. opii,	ʒss;
Aquæ,	℥ij.

This should be allowed to remain for some hours, when it may be changed for a dressing of dilute oil of cloves, or of cassia. All pain will usually cease with the application of an anodyne. When more active measures are demanded, the following dressing may be applied after the sterilization:

℞—Atropinæ sulph.,	gr. j;
Aquæ dest.,	℥j.

If the pulp shall have been wounded and bleeding ensue, or if there is exudation of serum from the exposed pulp, it may be dressed with a solution of tinct. iodine and persulphate of iron in equal parts. Tinct. opii may sometimes be necessary for the purpose of soothing the disturbed tissue. The inflammation and congestion once relieved, the necessary operative measures for the further preservation of the tooth may be instituted. If there is no actual pulp exposure these may, if skillfully executed, be confidently relied upon to serve their full purpose. If, however, any portion of the pulp tissue is really uncovered, the prognosis will not be as favorable. In the earlier stages of inflammation, before there is any exudation from the bloodvessels of the pulp, the best results may be predicted. If there has been extravasation of the contents of the blood channels into the body of the pulp absorp-

tion cannot be expected, owing to the absence of lymphatics, and breaking down of the tissue or death of the pulp will result.

The successive stages in degeneration may be tabulated thus:

	First Stage.	Second Stage	Third Stage.	Fourth Stage.
Symptoms	Sensitiveness.	Pain (cold exacerbates).	Pain (cold relieves).	Insensibility.
Condition	Irritation.	Infiltration.	Inflammation.	Stasis.
Pathology	Hyperemia.	Diapedesis.	Congestion.	Death.
Prognosis	Good.	Doubtful.	Bad.	Hopeless.

Stasis and death, as suggested by Dr. J. B. Willmott, may in some instances be partial in the third stage, while in other cases decomposition may have commenced in circumscribed areas and the change in the symptomatology may, at least in part, be due to the condensation of the putrefactive gases under the reduction of temperature.

The different remedies in the several classes that will prove best adapted to dental practice may be summarized as follows:

Food Laxatives.—Green and dried fruits, cracked wheat, oatmeal, etc.

Medicinal Laxatives.—Seidlitz powder, castor oil (doses for adults of 4 to 8 drams, and for children 1 to 3 drams), lac. sulphur (½ to 3 drams, in syrup or milk).

Saline Cathartics.—Epsom salts (2 to 8 drams in carbonated water), citrate of magnesia (dose according to preparation).

Diaphoretics.—Warmth and exercise, warm drinks. Dover's powder (5 grains, repeated if necessary), spirits of Mindererus (2 to 8 drams every two to four hours), sweet spirits of nitre (2 to 4 drams frequently).

Diuretics.—Diluent drinks, mineral waters, beef tea, whey, gruel, cream of tartar (1 to 4 drams combined with ½ dram biborate of soda), borax (20 to 40 grains).

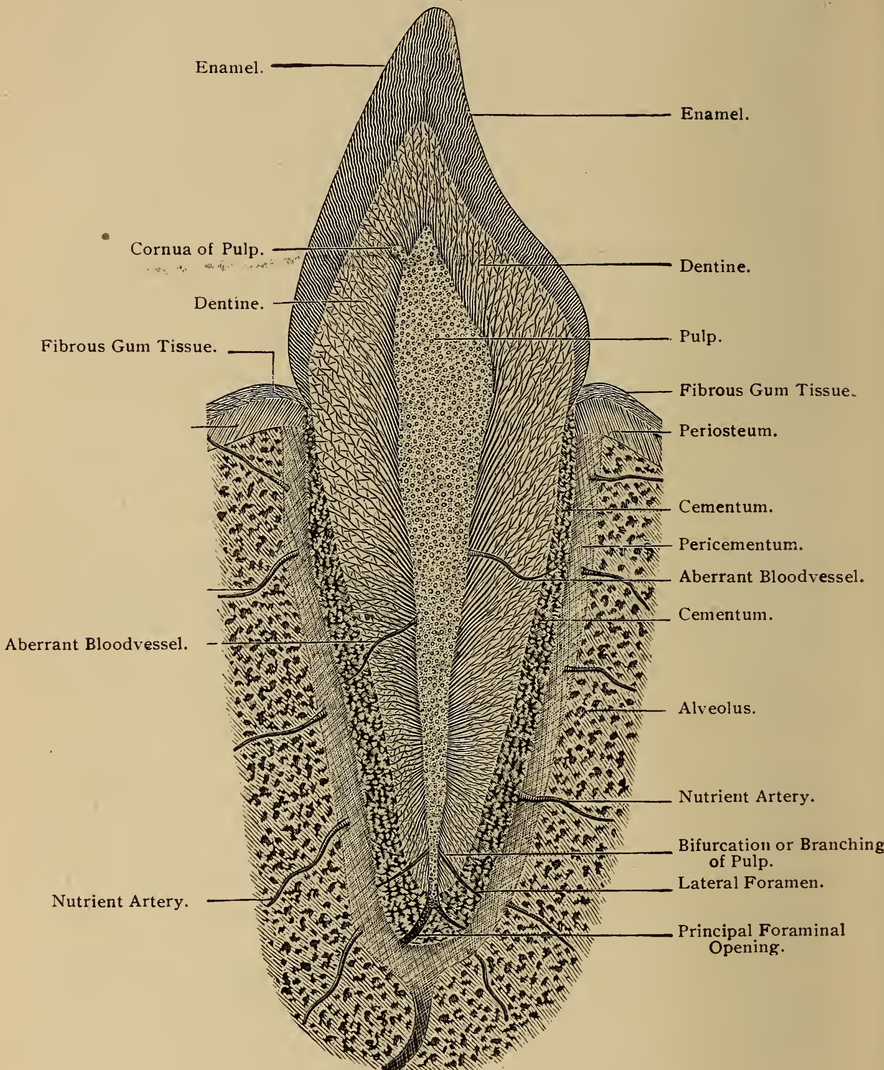
Anodynes.—Potassium bromide (5 to 20 grains), sulphate of morphin (⅛ to ¼ grain), aromatic spirits of ammonia (10 to 60 drops).

CHAPTER XXVI.

PERICEMENTITIS—INFLAMMATION OF THE PERIDENTAL MEMBRANE.

Sometimes this affection is closely connected with inflammations of the dental pulp, and it may be derived from mere con-

Fig. 27.



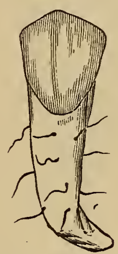
Nutrition of the Dental Pericementum and Pulp.

The condition here represented is that seen only in young persons. In later life the "aberrant" bloodvessels and some of the canals at the apex may be closed by the advancing calcification. The former are not constant but sometimes may be observed. Cementum is a modification of bone, and these vessels may have a genetic relation to Haversian canals. The cut is schematic and not according to scale.

tiguity or proximity of tissue. Usually, however, it arises quite independent of the other disorder, and indeed is more severe when the pulp has been devitalized, either by design or disease.

The pericementum is an exceedingly vascular organ, and it has an abundant nerve supply. This is necessary to its proper functional action. It is a kind of placental organ which affords the pulp of the tooth its vascular and nervous supply. The text-books and preparations which represent the arteries and veins of the tooth pulp as passing out at a single foraminal opening, perforating the pericementum and traversing the tissues until they anastomose with some larger vessel of which they are branches, and which is not in relation with the tooth at all, cannot be accepted as representative of the actual condition. No bloodvessel can be directly traced beyond the investing pericemental membrane. (See Fig. 27.)

FIG. 28.



TOOTH EXTRACTED BY AUTHOR FOR REPLANTATION, WITH MINUTE THREADS OF CHLORO-PERCHA FORCED THROUGH DENTINE AND CEMENTUM IN FILLING THE ROOT.

The foraminal opening of the normal tooth root is not a single direct aperture, having its axis in line with that of the pulp, but, especially in early life, is a delta with a number of communicating orifices, which begin to diverge near the apical junction of the dentine and cementum, and with a kind of circular sweep reach the pericemental membrane, with whose bloodvessels the branches from the dental pulp anastomose. Indeed, in early life the analogues of Haversian canals are not infrequently found penetrating the cementum and dentine at different points along the periphery of the tooth root, and containing accessory bloodvessels for the further supply of the pulp. Later in life these are usually obliterated by the advancing calcification. That this is true, the clinical observation of almost any dentist of wide experience might establish. There are few such who have not seen the whole apex

of a tooth root denuded through some pathological process, or by surgical operations, without interference with the vitality of the pulp. Many have known instances in which, through diseased action or by accident, one side of the root of an anterior tooth, with the whole of the apex, was completely denuded without any devitalization of the pulp. When this tissue has been restored by functional activity, the tooth was found as responsive to thermal changes as ever. The author has frequently had occasion to remove all the investing osseous tissue from a tooth root, save perhaps a comparatively small portion at one side, and that without final prejudice to its vitality. In some of these instances there

FIG. 29.

TOOTH WITH HYPERTROPHIED PERICEMENTUM SHOWING BLOOD SUPPLY.

Microscopical section demonstrated that nutrient arteries of considerable size entered at *a* and *b* and were distributed to the pericementum. (From a specimen furnished the author by Dr. D. E. Kulp.)

could have been no vascular supply to the pulp, unless it was through some kind of Haversian canal penetrating the cementum and dentine upon a lateral aspect. The author has frequently demonstrated the presence of something of this kind in freshly extracted young teeth. (See Fig. 28.)

It is well known to oral surgeons that resection of the inferior dental canal, with entire obliteration of the inferior dental artery and nerve, does not in any way interfere with the vitality of the lower teeth, which the text-books frequently represent as receiving their vascular and nervous supply from that source. These considerations should materially modify our views of the pathology of the dental pericementum, and change some previous conceptions of

its function and susceptibility to diseased action. In the light of these views, much that was before incomprehensible becomes plain and intelligible. We can understand why and how it is that the blood and nerve supply of the tooth is modified, and how it arises that the vessels of both are without the usual external muscular coats, and approach those of the brain in character.

Having the important and compound functions of affording the pulp of the tooth its nerve and blood supply and giving nutrition to the cementum and bone, and being in close relation with the gum tissue, the pericementum is very likely to take upon itself a pathological condition. Continued irritation of a mild character may result in a hyperplasia of the membrane, with an enlargement of the principal nutrient arteries and a generally congested irritative condition. (See Fig. 29.) It serves as a cushion to break the force exerted upon the tooth in occlusion, or from a blow, or any other external violence. Hence it is liable to injuries and accidents. It is also very subject to infection by micro-organisms from a decomposing tooth pulp. This last is without doubt the most fruitful source of inflammatory conditions, and such instances are constantly falling under the notice of the dentist and oral physician. Another common cause is the bad occlusion or absence of some of the teeth, which throws upon a few the work of many. Teeth used as anchorages for bridges of an extensive kind are peculiarly liable to and are often lost by pericemental irritation caused by overwork.

Many practitioners have no clear conception of the difference between pericementitis and pulpitis, inasmuch as each produces a distinct odontalgia or toothache which only close observation will distinguish from the other. And yet the two conditions have little in common except the pain, and that is not of the same character. It may be well to compare their pronounced symptoms as an aid in diagnosis.

Pulpitis.	*Pericementitis.*
The pain is of a sharp, lancinating character, and in its earlier stages it is distinctly paroxysmal.	The pain is dull, steady, boring, throbbing in its character, and is not at all paroxysmal.
The tooth is exquisitely sensitive to thermal changes; in its inceptive state cold, and in its later condition heat, exacerbating the pain.	There is no sensation to changes of temperature, and neither cold nor hot applications materially affect it.

Pulpitis (*cont.*).	*Pericementitis* (*cont.*).
There is no swelling of the tissue about the tooth, and no tenderness to pressure in ordinary cases, unless the pulp shall in some way be exposed.	The tooth becomes exceedingly sore, and the least pressure upon it causes pain. In the later stages swelling is common.
It is at times quite difficult to determine exactly which tooth is affected, the pain being fleeting in its nature, and inducing reflex symptoms in other teeth and tissues.	There is no trouble in deciding which tooth is the diseased one, the pain being steady in degree and in position, and the soreness readily locating it.
The pain is apt to be worse upon going to bed, and excitement and fatigue increase it.	The pain remains nearly constant without much reference to external conditions or circumstances.
It is possible to bite upon the tooth without any special sensation, and to use it in mastication, if thermal extremes be avoided.	The tooth is very sore to the touch, any occlusion in mastication or ordinary shutting of the mouth giving pain, irrespective of thermal changes.
The tooth is not elongated, nor does it strike first in occlusion.	The tooth is raised in its socket, and strikes before any of the others occlude.

Treatment of Pericementitis.

The first care should be to give the offending tooth rest, by preventing its occlusion. This may be done by placing gutta-percha caps over other teeth, to prevent the striking of this. The cause should be determined, and if possible removed. If it be infection from a dead pulp, the chamber should be carefully cleaned and sterilized, and an anodyne applied in the root channel, caution being exercised to avoid forcing septic matter through the foraminal openings. It may be advisable to seal up in it some of the essential oils, properly diluted, such as cassia or cloves, as an antiseptic. A counter-irritant should be applied over the apex of the affected tooth, for the same reason that it is used in pulpitis, and it is even more likely to be effectual. The same general remedies may be employed, such as saline cathartics, diaphoretics and nervous sedatives. Refrigerants are useful, and lumps of ice wrapped in muslin may be placed between the lip and the tooth.

If these are not effectual, resolution may sometimes be induced by hot fomentation upon the face and neck. Prof. C. N. Johnson recommends that water as hot as can be borne be directed upon the part, with some force, for twenty or thirty minutes, to

promote resolution. An acute pericementitis has also been readily aborted by the precisely opposite treatment of directing an ether or rhigolene spray upon the part until it has become bloodless. Both are useful, but are best adapted to different stages of the disease. If infection is present Prof. A. W. Harlan recommends the administration of one-tenth of a grain of calcium sulphide every ten minutes for an hour, the interval then to be gradually increased. If there is a great degree of pain, the following may be administered:

℞—Acetanilid.,	gr. viij;
Syr. simp.,	ʒij;
Spts. frumenti,	ʒij.

Sig.—One-half at 6 P.M., the remainder two hours later.

The patient should be given a hot foot-bath, placed in bed and kept warm. If the inflammation is exceedingly acute, scarification of the gums about the affected tooth may be resorted to. If there is great tension of the tissue, a sharp-pointed scalpel or bistoury may be used to cut through the gum tissue over the apex of the tooth, a little cocain having been previously applied, or the point of the instrument dipped in pure carbolic acid and applied to the surface until it has become white, when it may be forced through the alveolar walls until the seat of inflammation is reached, thus removing the tension and giving immediate relief.

CHAPTER XXVII.

ALVEOLAR ABSCESS.

An Abscess is the formation of pus somewhere within the body, as the result of some local or circumscribed inflammation. An Alveolar Abscess is an infective inflammation within the alveolar walls. It may be the result of some foreign substance acting as an irritant, or some injury may have been the exciting cause. Either of these agencies may result in an inflammation so violent as to induce a breaking down of tissue, and infection with suppurative organisms will induce the formation of pus, which reaches the surface by the route presenting the least resistance. An alveolar abscess does not, therefore, necessarily presuppose the death of the pulp. If the inflammation does not materially affect

that tissue, or if the pericementum involved does not include that from which the blood supply of the tooth is derived, an alveolar abscess may be established without pulp devitalization.

The terms "abscess" and "ulcer" are frequently confounded. Even dentists of intelligence speak of an "ulcerated tooth," when practically such a thing is an absurdity. An abscess and an ulcer have little in common. The primary cause of the first is infection by some pyogenic organism, which necessarily has no part in inducing an ulcer. An abscess always forms in some cavity within the body: an ulcer always has its inception on an external cutaneous surface. An abscess is a circumscribed collection of pus: that is

Fig. 30.

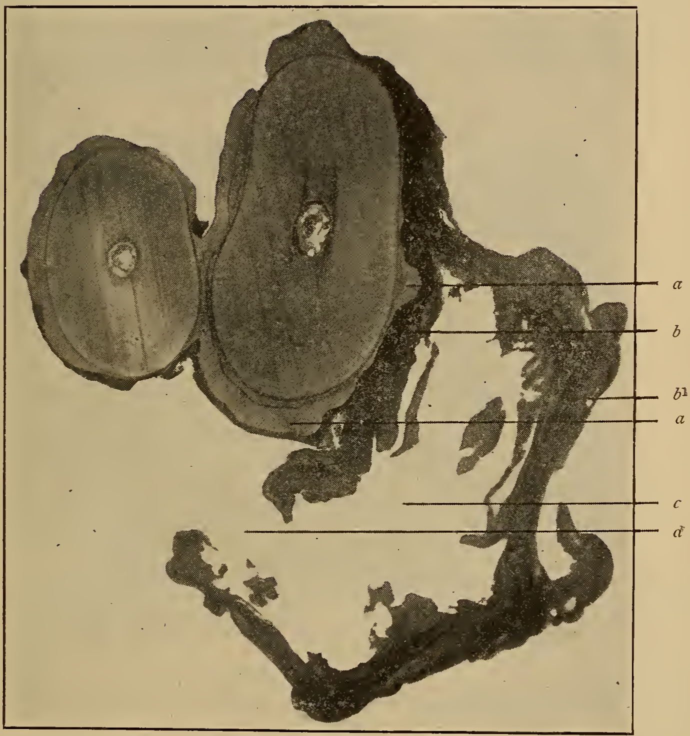
Pericemental Abscess which in No Way Involves the Vitality of the Tooth Pulp. (E. C. Kirk.)

not at all true of an ulcer. The one makes progress from within outward: the other just the reverse. The one tends toward resolution: the other is progressively degenerative. An abscess is always the result of a recent lesion: an ulcer is never connected with a fresh wound or infection, but has its inception in some old injury or morbid structural change. It would be difficult to instance a grosser misuse of technical terms than the calling of an alveolar abscess an "ulcerated tooth."

Professor Kirk has demonstrated that a pericemental abscess may develop in the parenchyma of the membrane; that is, it may be

neither supra- nor infra-, but intra-pericemental. (See Figs. 30 and 31.) It is indeed probable that such abscesses are more frequent than is usually supposed. Most practitioners of experience have at some time in their lives drilled into an abscessed tooth and found a living pulp, which would demonstrate that the lesion was not at the foraminal apex. By the study of these conditions Pro-

FIG. 31.



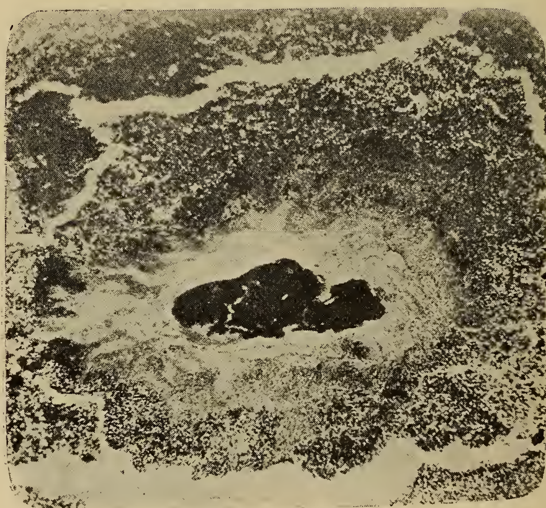
TRANSVERSE SECTION ACROSS BUCCAL ROOTS OF FIG. 30, SHOWING THE ABSCESS-CAVITY TO BE BETWEEN THE PERICEMENTAL WALLS.

a, *a*. Hypercementosis. *b*. Thickened pericementum covering root. b^1. Thickened pericementum forming external wall of abscess-cavity. *c*. Abscess-cavity occupying central portion of divided pericemental membrane. *d*. Section through fistulous outlet of abscess. (Kirk.)

fessor Kirk believes he has found a common factor of infection to be the diplococcus of pneumonia, or the pneumococcus of Friedländer, with occasionally staphylococcus pyogenes aureus as a concomitant.

But such a condition is not that which has usually been denominated alveolar abscess. The common acceptation of the term is that affection which is the result of inflammation and death of the pulp, its infection, and the consequent inflammation and infection of the pericementum from contiguity of tissue. If we take up the subject of the last chapter at the point of its closure, and suppose the pulp of a tooth to be devitalized as the result of stasis of the blood currents, with the consequent stoppage of all nutrition through a distinctive inflammation, the next inquiry will be concerning the final disposition of the devitalized pulp.

Fig. 32.



Metastatic Abscess.

Mass of staphylococci in the center, surrounded by an area of coagulation necrosis, the whole inclosed by a cordon of leucocytes. (Kirk.)

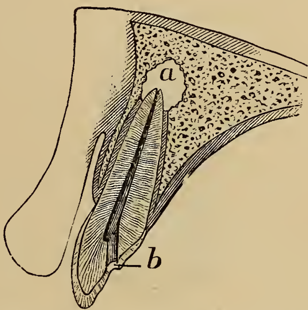
If there is no source through which it can become infected with micro-organisms, it will probably become mummified and desiccated; the moisture will be absorbed from it, and it will assume the condition of dry gangrene, in which it will remain for an indefinite period without being the cause of any irritation whatever.

If, however, such a pulp chamber be opened without the strictest antiseptic precautions, perhaps years after the death of

its contents, germs of infection may be carried in upon the non-sterilized instruments or admitted with a particle of saliva, and septic inflammation, with perhaps consequent alveolar abscess, will be the result.

The infection may arise from either one of two sources. If there is a cavity in the tooth that penetrates to the neighborhood of the pulp, the bacteria may there find entrance, and decomposing the pulp tissue by putrefaction they may cause the formation of offensive gases, which forcing their way through the foraminal openings will act as an irritant upon the pericementum, and induce an acute inflammation of that tissue.

FIG. 33.



BLIND ABSCESS AT THE ROOT OF AN UPPER INCISOR.

a, Abscess cavity in the bone. *b*, Drill hole exposing the pulp chamber for drainage. (Burchard, after Black.)

If there is no special cavity of decay in the tooth containing the recently devitalized pulp through which infective organisms may find entrance, it may still become contaminated from some other center of infection that may exist in the body. The bacteria may be transported by the blood or through the lymph tracts, or may in some other manner be carried within the body to the dead tissue, and in this manner form a source of contagion. By whatever method the pulp becomes inoculated with putrefactive or suppurative organisms, whether from external sources or by auto-infection, the result will be the same,—the formation of suppurative products and the infection of the pericementum and other tissues in the neighborhood of the foraminal openings. Pus will thus be formed and an abscess established (see Fig. 33).

Incipient Alveolar Abscess is the term applied to the condition

that has existed up to this point. It simply implies the earlier stages of the destructive inflammation, before pus shall be actually present, during which period it may be possible to abort the abscess, or prevent the breaking down of tissue.

A Blind Abscess is one in which there is a cavity of decay communicating with the pulp chamber, and in which it is possible for the pus to be drained through the pulp canal.

A Discharging Abscess is that condition in which the pus forces its way to the surface through the alveolar walls and establishes a fistulous opening.

The formation of an alveolar abscess depends upon infection by septic organisms. These are always a source of irritation, and

FIG. 34.

INFECTED EXUDATE ABOUT THE APICES OF THE ROOTS OF A MOLAR TOOTH IN A CASE OF SUBACUTE PERICEMENTITIS.

The center of the mass consists of pus and broken-down tissue; the superficial portion is the desiccated exudate not yet decomposed.

induce inflammatory conditions. The pericementum about the foraminal opening of the root of a tooth being thus affected, there will ensue under the stress of the inflammatory conditions the phenomena described in the chapter (VI.) on General Inflammation. There will be changes in the bloodvessels of the vascular tissues that will finally result in diapedesis, or the pouring out of the plastic lymph. This will be infected by the organisms, and instead of being either removed by resolution or built up by regular progressive metamorphosis, it will be broken down. The leucocytes, or white blood corpuscles that have thronged to the irritated neighborhood, will lose their vitality through the irritation and infection, and assume the character of pus corpuscles; the investing tissue will be broken down and decomposed, thus forming a

cavity about the foraminal opening; the water of the tissue and the serum of the blood will mingle with these, and the whole mass will be that fluid that forms the contents of the abscess cavity.

If, now, an opening be drilled to the pulp chamber this septic matter may be discharged through the pulp canal and a blind abscess will be the result. (See Fig. 33.) If there is no surgical interference the pus will make its own way to the surface by the line of least resistance, and there form a fistulous opening.

There may be about the periphery of this pus cavity, when so formed through the breaking down of the tissue, a partial attempt on the part of nature to build the exudate into new tissue. It may possess a kind of consistence, and this partially organized, partially desiccated plastic lymph will form a line of demarkation that will inclose the disturbed territory. (See Fig. 34.) Upon its external surface it will exhibit the characteristics described, but its center will be a collection of pus and disorganized lymph. If the tooth is now extracted, this mass may be found clinging to the root, the size of an ordinary pea, and when so removed with a deciduous tooth it has been mistaken by the unintelligent for the germ of a permanent tooth. It is only the plastic exudate that filled the cavity produced by the breaking down of the tissue, whose surface is desiccated or dried, while its interior is completely broken down.

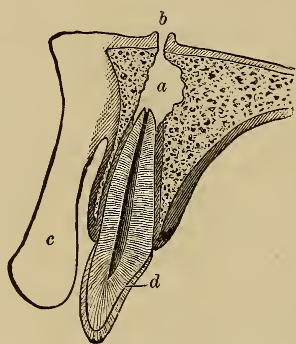
The infected point may not be at the foraminal apex of the tooth, but may be at some point upon the side of the root, or between them at their point of divergence.

The fact that the blood and nerve supply of the dental pulp are derived from the pericementum, and that channels analogous to the Haversian canals of bone may in comparatively young persons communicate with the pulp through the cementum and dentine at almost any point, naturally introduces another complication in the proper treatment of so-called dead teeth. Not infrequently is an exceedingly sensitive point found somewhere along its course when a broach is passed into the pulp canal of a devitalized tooth, and it may be that the oozing of blood and serum from such a point, even after the foramen has been stopped, will give great annoyance. This may be the mouth of one of these communicating blood channels, and it is easy to comprehend that the pericementum at the point at which this is given off may readily become infected from a septic canal, and thus form a focus

of inflammation and disorganization quite distinct from that about the usual foraminal opening. The latter may be thoroughly drained and completely sterilized without beneficial result, because it is reinfected from another opening in the pulp canal as fast as it is rendered aseptic. In teeth having more than one root these collateral vascular branches are sometimes given off from the pericementum at the bifurcation, and at these points may be established a focus of infection and inflammation which it is difficult thoroughly to drain, and impossible entirely to disinfect and sterilize.

Pus having once formed at any point about the periphery of a tooth, it becomes necessary for it to be evacuated, as it is essentially a foreign body possessing peculiarly irritating properties.

Fig. 35.



Alveolar Abscess at the Root of a Superior Incisor Discharging into the Anterior Nasal Fossa.

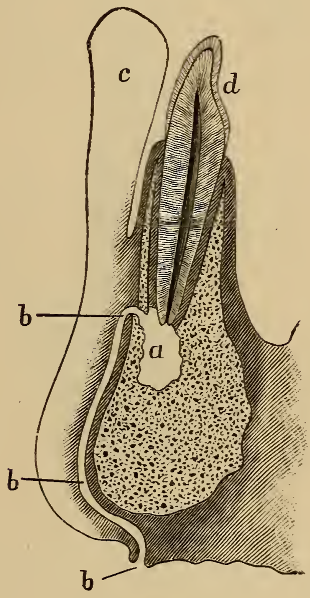
a, Very large abscess cavity in the bone. *b*, Fistulous opening in the nasal cavity. *c*, Lip. *d*, Tooth. (Black.)

It usually secures egress through the breaking down of the tissue that encompasses it. The pressure of the gases of putrefaction that are evolved, with that of the constantly increasing pus, causes resorption of the investing bone, while the inflammation and infection induce progressive decomposition, and thus an opening is made to the surface, the pus is evacuated and the acute symptoms pass away.

If no remedial measures are instituted, the sinus perhaps then closes up and the patient may fancy that a cure is established. But the pericementum at the infected point, and the tissues about it immediately involved, remain in a septic condition, and the

efforts of nature to restore a true physiological condition are made futile by constant reinfection. An acute inflammatory stage again ensues, the plastic exudate is once more poured out, only to be reinfected, with a fresh breaking down into pus. The abscess "gathers" again, but this time, as the old sinus will not have been completely obliterated, there will be less resistance, and the pus will with decreased difficulty reach the surface. This process may be periodically repeated until a complete and con-

FIG. 36.



CHRONIC ALVEOLAR ABSCESS WITH FISTULA DISCHARGING UNDER THE CHIN.

The pus burrows through the soft tissue beneath the periosteum until it reaches the point of exit. *a*, Abscess cavity in the bone. *b*, *b*, *b*, Course of fistula. *c*, Lower lip. *d*, Inferior incisor. (Black.)

tinually patulous sinus shall have been formed, when all acute symptoms disappear and a chronic abscess is established, through the disorganization of the nutritive currents and the continuous effusion and uninterrupted infection and breaking down that ensue. This condition may persist until a cavity of considerable extent has been formed in the alveolus, or even in the body of the bone.

The course of the pus in reaching the surface in the usual

forms of alveolar abscess is directly through the thin alveolar walls. This is the shortest route, and the one that ordinarily presents the least resistance. But although the tendency of the pus is toward the nearest point of exit, the external plates of the bone are usually compact tissue, while the interior is cancellous. Because of this fact the burrowing may be through the less dense portions of the bone and away from the usual course.

Fig. 37.

Separation of the Periosteum from the Bone by the Burrowing of Pus from an Alveolar Abscess.

a, Abscess. *b*, Pus pocket beneath periosteum. *c*, Lower lip. *d*, An inferior tooth. *e*, Tongue. (Burchard, after Black.)

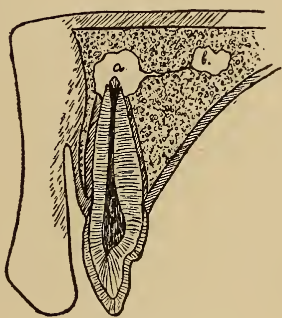
The pus may find some cavity of the body and be discharged into the posterior or anterior nares, or into the maxillary sinus. In such instances the diagnosis may be extremely difficult. Many cases are on record in which treatment had for a long time without avail been directed toward complications which did not exist in reality until a more careful examination revealed a dead tooth as the source of all the trouble. (See Fig. 35.)

Sometimes the pus will penetrate the alveolar walls, and, encountering the fascia of a muscle, follow along its course until it

reaches a point considerably distant before it finally finds the surface. A discharging abscess under the chin, the direct result of a devitalized inferior incisor tooth, has often puzzled the medical man, who never once thought that the dentist might give quick relief. (See Fig. 36.) Pus has been known to burrow along the fibers of the platysma myoides muscles until it has reached the clavicle, or, penetrating the cervical fascia, finally strike the omo-hyoid and follow its course until it emerged at the point of the scapula.

In some instances of rather indolent abscess, the pus makes its way through the alveolar walls until it reaches the periosteum of the bone, which it detaches, and spreading out beneath it completely cuts off all periosteal nutrition. (See Fig. 37.) This is a condition which, if not relieved, may result in osseous necrosis. It may be

FIG. 38.



ALVEOLAR ABSCESS.

a, Primary abscess pocket. *b*, Secondary pocket caused by the infiltration of septic matter through the cancellous bone tissue.

observed more frequently in the vault of the mouth, when the pus has penetrated the palatal process of the superior maxillary. The tough, fibrous character of the tissue immediately beneath the mucous membrane of the roof of the oral cavity presenting a great obstacle to the course of the pus, it not infrequently spreads over a considerable portion of one side of the vault.

There are cases in which the pus burrows to some distance in the alveolus, establishing separate pockets which become distinct points of infection. (See Fig. 38.) In one such instance, from an infected point at the apex of a superior cuspid, which had a discharging sinus between that and the point of the lateral incisor, and

which persistent treatment failed to cure, a secondary sinus was finally traced back to a point between the first and second premolars, or bicuspids, where was a second focus of infection, and from this another led yet farther, back of the roots of the second bicuspid, where there was a third pus chamber. It was not until all these were explored and sterilized that anything approaching a cure could be obtained.

These secondary pockets, or foci of infection, whether upon the periphery of the tooth as the result of a former collateral blood supply to the pulp, or existing as pockets within the alveolus in consequence of the burrowing of pus back into the bone, are especially perplexing to the practitioner, because he never knows when to expect them, and he has no early means of diagnosing the exact location of the seat of the trouble. After the proper disinfecting and sterilizing process has been resorted to in vain, it may be suspected that there are somewhere foci of infection that have not yet been reached by the remedies used. The continuation of the discharge of septic or sanious matter indicates that disinfection and antisepsis are not complete, and no entire cure may, under such conditions, be expected.

CHAPTER XXVIII.

SYMPTOMATOLOGY AND TREATMENT OF ALVEOLAR ABSCESS.

The objective as well as the subjective symptoms of Alveolar Abscess are sufficiently pronounced to prevent any mistake in diagnosis. That which is under special consideration, the result of the infection of the contents of a pulp chamber or canal, begins with a pericementitis that gradually increases in severity. The soreness is extreme; the tooth is materially lifted in its socket and becomes loose, with that peculiar feeling of non-support that indicates fluid at the extremity. This is the extravasated lymph and serum. Within a few hours there is the distinct febrile condition, with its elevation of temperature, quickened pulse and succeeding rigor—the septic fever that invariably indicates the formation of pus and which is idiopathic. The red line or red blotches that are characteristic of pericemental inflammation, and which are peculiarly observable up to this point, now begin to fade away

or to be succeeded by a deep red that is continuous with that of the neighboring tissues, and there is, in very acute cases, a tumor or distention of the alveolar walls. The pain, which is deep-seated, continuous, and of a boring character, is now intense, but there is little swelling of the soft tissues.

The pus is burrowing its way toward the surface of the bone, and the pressure exerted by the confined matter is the source of the suffering. This continues until the alveolar walls have been penetrated, and the pus escapes into the soft tissues. Great swelling now ensues, with subsidence of the pain, consequent on the escape of the confined fluid into the tissues that can yield to the pressure. Sometimes the infiltration of the tissues and diffused cellulitis are so great as to close the eye and greatly distort the face. But, although the appearance at this stage is much more serious and alarming that at previous ones, the pain and soreness are very much less, and the tension is relieved. Finally, there is "pointing," fluctuation may be distinctly detected beneath the finger, and the abscess is ready for the lancet.

The general indications of a septic condition, the infection by pyogenic organisms, and the formation of pus, will be as follows:

1. *Anorexia, or loss of appetite and general tone.*
2. *Chills or rigors, which are more or less pronounced.*
3. *Headaches, sharp, persistent, and blinding.*
4. *Fever of a distinct type,—the septic fever.*
5. *Tongue coated and covered with dark-colored fur.*
6. *Constipation, persistent, but without special pain.*
7. *Urine scanty, of high color and specific gravity.*
8. *Nervous disturbance, which constantly increases.*

The latter symptom may be more or less apparent, depending upon the gravity and severity of the attack. In slight cases, like ordinary alveolar abscess, it may amount to nothing more than uneasy restlessness, while in general septic conditions there may be violent delirium. The appearance of these symptoms marks what is called "septic-" or "auto-intoxication," or period of functional excitement produced by the absorption of septic or poisonous matter.

If there are wounds of any kind through which infection takes place their edges will become red, swollen, tense, and angry in appearance.

In addition to these general indications there will be local manifestations, which may assist in making a diagnosis.

If the pus pocket is superficial there will be "fluctuation," or that feeling beneath the finger of softening, yielding, and undulation that is the sure sign of the presence of a fluid. The abscess will begin to "point,"—to determine toward a single spot and to show an angry, red, or softened elevation above the general surface.

If the pus is deep-seated and "pointing" is not indicated, or is toward some cavity within the body, the superincumbent tissue will appear glistening, and will lose its elasticity. If indented with the finger it will blanch, and the color will not at once return to it upon removal of the pressure, while the indented pit will persist for a little time because of the loss of resilience or springiness.

Treatment.

Abortive measures should be instituted in the early stages of the pericemental inflammation. At this time counter-irritants, hot foot-baths, with laxatives and diaphoretic remedies, will be found useful. If a dead pulp is present, the pulp chamber should be opened under the strictest antiseptic precautions.

The rubber-dam should be placed upon the tooth, to segregate it from the septic fluids of the mouth. The drill should be carefully sterilized, either by heat or by being allowed to remain a little time in some germicidal fluid. *Débris* should be removed from the cavity of decay, if such cavity exists, and it should be effectually sterilized with a bichloride or some other energetic solution. As soon as the walls of the pulp chamber are punctured, the drill should be withdrawn and a sterilizing solution injected or carried in upon a pledget of cotton. The opening may now be enlarged, and the antiseptic or germicide carried to every possible point of the pulp cavity and canal. With a sterilized broach, all *débris* and remains of the decomposed pulp should be removed, and the canals made as clear of obstruction as possible. A few fibers of cotton dipped in some antiseptic, such as one of the essential oils, may be carried as near the apex of the root as possible, and sealed up in the cavity. If there is much pain, some anodyne, like tincture of opium, may be introduced into the canal on a very few fibers of cotton.

This treatment, both local and general, should be continued

until the inflammation with its soreness and pain shall have passed away, when operative measures for the preservation of the tooth and its protection from further attacks may be instituted.

If from any cause the treatment shall prove ineffectual, the inflammation gradually becoming worse until the symptoms give indication that resolution cannot be expected, that degeneration has already commenced and septic infection has taken place, the treatment should be promptly changed, and suppuration encouraged. The general abortive measures must be abandoned, and the pus directed toward the surface. Warm fomentations may be used, a cloth wrung out in hot water being applied to the face over the seat of trouble, and carefully covered, while the patient is kept warm. Indications of "pointing" must be carefully noted, and any tendency toward the exterior of the face should be repressed by painting it over with an iodine solution, the application of cold, and other like measures. A poultice consisting of the fresh surface of a split fig, or raisin, that has been warmed and softened in hot water and sprinkled with capsicum or red pepper, should be placed over the alveolar wall opposite the root of the tooth, or within the oral cavity where it is desired that the abscess shall point, and suppuration invited by that channel. This process should be hastened by every available means, that the formation of secondary pockets, with osteitis, or inflammation of the bone corpuscles, may be avoided. If the indications are that the pus is burrowing in the wrong direction, thus threatening a prolongation of the condition, with the probable infiltration of the bone by septic products, the practitioner should lose no time in reaching the disturbed place with an instrument, and thus establishing a sinus at the proper point.

The pus evacuated, the next step should be the disinfection of the whole territory. The pulp chamber should be opened and cleaned out, and the principal foraminal opening made patulous. About the extremity of the point of a suitable metal syringe, a rope made of a sufficient quantity of cotton fibers dipped in a chloro-percha solution may be wound, the point introduced into the cavity of decay, or that artificially made into the pulp chamber, and the cotton then closely packed around it. The barrel of the syringe filled with tepid water may now be attached and considerable force used until the stream entering at the pulp chamber emerges at the

fistulous opening. The barrel of the syringe is now removed and filled with a solution of three per cent. pyrozone, or with electrozone, and this is injected as a disinfectant. This is succeeded by a solution of bichlorid of mercury or some other effective germicide, and the cavity may be sealed up for a day or two.

It may be advisable to wait for a little time after an abscess shall have broken or been opened before this cleansing and sterilization is attempted, that the pus may be well evacuated and the acute symptoms have had time to subside. It is well to establish the sinus and wash out the tract primarily, because if a coagulant is employed before the pus is removed there may be such a clot formed as will effectually stop the channel.

If at the end of sufficient time the indications warrant the belief that sterilization is complete, and that there are no secondary pockets of infection, the root may be permanently filled. If, however, the septic condition continues in the least degree, or if there are signs of osteitis, the cavity should be opened and the sterilizing process repeated, or an antiseptic anodyne introduced still further to test the case.

If the fistula is an old one and the abscess not of recent formation, and especially if there are no acute symptoms, thus indicating a chronic condition, something more active should be introduced as an antiseptic. After the cleansing out of the pulp chamber and the root canal, the rubber-dam should be applied and a broach wound with cotton fibers dipped in a saturated solution of carbolic acid introduced, and the caustic antiseptic pumped through the tooth and along the sinus until it appears at the fistulous opening, where it may readily be detected by its turning the tissues white. This cauterizes the whole tract, inducing sloughing to a limited extent, and brings on acute symptoms, with effusion of plastic lymph, which in the thoroughly sterilized territory may be built into tissue by regular progressive metamorphosis.

A solution of chloride of zinc, five grains to the ounce, may be forced through with a syringe in these chronic cases, and this may bring about an acute condition and stimulate the indolent functional activity. Some operators proceed at once to fill after a single treatment such as has been indicated, but unless there are special reasons for haste it is better and safer to wait until it has been thoroughly demonstrated that there are no secondary pockets or

foci of infection, and until the reparative process and the up-building of the waste territory has fairly commenced. This may usually be determined by the dryness of the root canal. To test this a fine broach should be thrust to the apex of the root, or as far as possible, quickly withdrawn and wiped upon a piece of rubber-dam. Any moisture will show at once, and will indicate that there is still a septic condition.

There are instances in which it is impossible to force fluids through the foraminal opening or openings. This will more frequently be the case with the molar teeth, in which perhaps the infected point will be at the opening of one of the buccal roots, but it may occur with even the anterior teeth. Some operators insist that they are able to open the apices of such roots with a drill, but when it is recollected that seldom or never is the foraminal opening in a direct line with the canal, it will be found that none except men of the most phenomenal skill will be equal to this task. The average operator will hesitate before proceeding to such heroic measures.

If it is impossible to pass a flexible broach through the foraminal opening, or to establish communication between the outside and the inside of the apex of the tooth, after the cleansing of the canal and the use of the general remedies recommended, the antiseptic may be introduced on a few fibers of cotton as near the apex as possible, and then sealed up within the tooth. The agent used should be one that is of as penetrating a nature as possible, and the experiments of Miller show that in this respect none possess any special advantage over pure carbolic acid. The pulp chamber and canal should be completely flooded with the remedy, and it should be changed as often as necessary, sometimes every hour, until the pulp canal is thoroughly and completely sterilized. Then by slow infiltration and absorption it will be carried beyond the apex of the tooth and sterilize the investing tissues. It may be necessary to continue such treatment for some time, especially when the inflammation is of an indolent, subacute character. But when the process is complete the sinus that may have existed will disappear, and all inflammatory signs will depart.

Treatment from the outside is the only resource in those instances in which none of the usual curative measures are effectual. Sometimes it is impossible to get through the foraminal opening,

or perhaps the dentist has been too precipitate in filling the root and tooth with a material that it is difficult to remove. In such a case the seat of disturbance must be reached by establishing a sinus, or through that already in existence. With a properly shaped spring-tempered probe it is usually possible to follow the course of a discharging canal to the apex of the root. A few fibers of cotton wet with a solution of carbolic acid should first be introduced as an obtundent and cauterant, and allowed to remain for a short time. The probe is then introduced and the sinus carefully explored to its extremity. It will usually be found that the opening through the external alveolar wall is considerably above the fistulous opening, and its course may not be a direct one. But a little patience, with the knowledge obtained by some experience, will enable one to reach the apex of the root with comparative readiness, provided the lesion is not upon the palatal root of a superior molar. Having clearly outlined it, the opening may now be enlarged with a trephine or drill, if it is necessary, and the proper remedies carried to the diseased point. Deposits may be removed from the root, or its apical point amputated if necessary. All *débris* having been removed, and the parts carefully sterilized, granulation from the bottom will probably close up the opening. If it does not, the operator may be assured that there is dead or foreign matter in the cavity, or that it has not been effectually sterilized.

In filling a sterilized devitalized root, it is not at all essential that the filling material shall be pushed farther than the junction of the dentine and cementum, at the point where the division of the canal into the foraminal delta begins. The broach will readily indicate this point, because it is sensitive beneath it. It is only the dentine that is devitalized, the cementum which forms the real apex of the root retaining its vitality. The delta or divided canal exists within the living cementum, and hence does not need to be filled. Dentists sometimes find this point exceedingly sensitive, and imagine that the pulp is not yet wholly devitalized. They perhaps introduce a second application of arsenical paste, and so do considerable injury. They should remember that the cementum at the apex is probably in an irritable condition, and needs an anodyne rather than another dose of a corrosive poison, the effect of which upon the already inflamed living corpuscles may be to induce death of the cemental apex and necrosis of the investing tissues.

There are instances in which the inflammation stops short of the formation of pus and results in an indurated mass, sometimes of considerable size. The plastic exudate has been poured out, and has infiltrated the tissues and caused a distinct swelling. But the degenerative process has not begun, either because there is no septic infection or because sterilization has destroyed the organism. The inflammation is of a low, subacute character, and there is no pain or violence. The plastic exudate loses its usual consistence, either through the extraction of its watery part or because of some fibrous organization or other change, and becomes indurated. The swelling is perhaps within the bone, and there is a distinct protrusion of the external wall. This condition may remain for an indefinite time, and it sometimes causes considerable deformity of the jaws.

If this is the result of a pericemental inflammation at the apex of a devitalized tooth, resolution or reabsorption may usually be brought about by the injection through the tooth of tincture of iodine. If the foraminal apex is not open, cotton saturated with tincture of iodine may be sealed up in the tooth cavity, and changed as necessity requires, until the process is completed. If the offending tooth is extracted, there will usually be immediate resolution, but this is not always advisable, and the iodine treatment may be resorted to for the slow relief of the indurated condition.

CHAPTER XXIX.

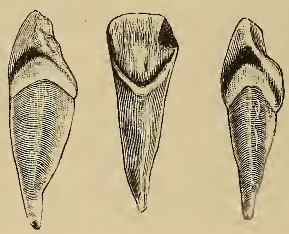
DEPOSITS UPON THE TEETH.

Under this head will be considered such superficial precipitates of inorganic matter as may induce possible pathological changes. They must be derived either from external sources or from some of the fluids of the mouth or the body. There are many forms of oral *débris,* the sediments of organic matter, deposits of food, etc., that will not properly come within this category. The "white deposit," that cheesy deposition that is so often found encircling the cervical portion of the tooth and forming a

narrow white line just at the gum margin, belongs to the latter class. It is composed of the *débris* of food that is partially fermented, micro-organisms, etc., and when it has been allowed to remain for any length of time the tissue immediately beneath it will be found partially decalcified and softened. But the deposit itself is not of a calcareous nature, and is easily removed by the brush.

The so-called "green stain" of childhood is wholly superficial and has no special pathological signification, except so far as it may be a symptom of some unhealthy condition of the fluids of the mouth. It is called "green" stain, although it may be dark, or bronze, or yellow in color. It has by some been considered a disease-producing kind of fungus, which penetrates the substance of the enamel, disintegrating it, and thus injuring the tooth. But if one

FIG. 39.



GREEN STAIN ON THE APPROXIMAL SURFACES OF INCISORS.
(W. D. Miller.)

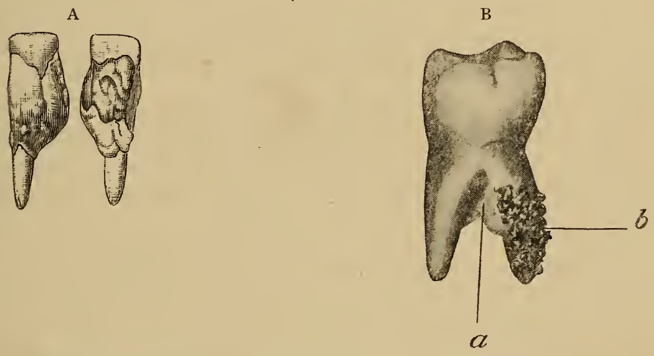
will immerse a tooth discolored by it in a ten per cent. solution of lactic acid he will in a few moments see the so-called Nasmyth's membrane separate from the tissue, and it will carry with it all the deposit, leaving the exterior white and uneroded. Sometimes it is found upon the surface of eroded or even decayed enamel, but it can be removed in such a manner as clearly to indicate that it was deposited subsequent to the erosion or caries. (See Fig. 39.)

Salivary calculus is a deposit from the saliva. If one will through a tube breathe into a glass of lime-water, he will soon observe that the fluid becomes milky in appearance. If he will continue the process for a while, and then set the glass where it will be entirely undisturbed, he will after a time find deposited upon the bottom more or less of a fine amorphous powder. This

is the calcium that was held in solution in the water, and which was thrown down as carbonate of lime. A few drops of hydrochloric acid will clear up the fluid by again dissolving the precipitate.

It is not asserted that this is the method in which salivary calculi are formed, but it illustrates the precipitation of calcific matter. The calcium salts are really held in solution in the saliva by means of the carbon dioxide which it contains. When the fluid enters the oral cavity it at once encounters acids which may be present, and is subjected to fermentative and other active and chemical influences, which result in the precipitation of the calcium salts, and these, with some extraneous matter, form the calculi. Naturally, this deposition will be greatest near the mouths of the salivary ducts, and so the principal calculi are upon the inferior

FIG. 40.



A. SALIVARY CALCULUS CAUSING RECESSION OF GUM AND ABSORPTION OF ALVEOLUS.
B. MOLAR WITH DEPOSITS OF SANGUINARY CALCULUS AT *b*. AT *a* NECROTIC PERICEMENTUM AND BROKEN DOWN EXUDATE.

incisors, opposite the mouths of Wharton's duct, and upon the superior molars in the neighborhood of the discharging mouth of the duct of Steno. (See Fig. 40, A.)

Sometimes this material is precipitated in great quantities, binding several teeth together in one mass. In some instances the utmost care of the patient will not enable him to keep the teeth entirely free from it. When this is the case it is usually soft, of a creamy yellow color, and is easily removed. When it is deposited more slowly it has time for consolidation and becomes hard, and is usually stained a dark color by pigmentary matter from the oral cavity.

It has no special pathological signification aside from the fact that it is a mechanical irritant, and keeps the teeth and mouth in a filthy condition by constantly acting as an absorbent, and as an obstruction against or under which food *débris* lodges. It should be carefully removed with instruments, the teeth polished, and, if necessary, the irritated gums touched with a stimulating astringent.

The so-called sanguinary or serumal calculus is distinguished by separate characteristics, and is due to other or modified conditions. It is not found external to the margins of the gums, nor does it always appear to be a precipitate from the oral fluids,—for no reference is here intended to the hard, black, smooth, supragingival, slow deposit which is but a modification of the usual form of calculus and is undoubtedly of salivary origin. The so-called serumal deposits are upon the periphery of a root that is not denuded when they are formed. They may be found when there is absolutely no break at the gingival border, and when consequently their precipitation from the oral fluids would seem to be an utter impossibility. Instances of this are cited in the chapter on Pyorrhea. (See Fig. 40, B.)

It is not deposited in a smooth, continuous, amorphous mass, as in the case of salivary calculus. It is found in dense, hard, closely attached, separate nodules, which may by further deposition become confluent.

It cannot be scaled off cleanly and readily, as can the oral variety. It clings so closely as to make it necessary to chisel it away, in which process, unless great care is used, a scale of the tooth may be taken or a thin layer of the deposit left. It has not the same color as the salivary concretion, the latter, except when it has been discolored by subsequent pigmentary deposits or infiltrates, being of a dark yellow or yellowish white color. The so-called serumal or sanguinary deposit is of an olive-black tint, with sometimes an olive-green tinge. It is not identical, either in color or in manner of deposition, with salivary concretions.

It is more distinctly irritating to the tissue than is the salivary deposit. Perhaps the location of it within the tooth socket may serve to account for the difference, but aside from that there appears to be a rather distinctive irritation in its presence, not known in connection with the salivary deposit.

Chemical analysis shows that there is a synthetic difference

between the two, for, while calcium forms the base of both, the serumal contains certain elements not found in the other. The analyses of it have not been sufficient in number or so exhaustive in character as to reveal all that may probably be learned from them.

Perhaps the most reasonable and consistent theory of the formation of this calculus is that of Professor E. C. Kirk, and it may be thus summarized: The capacity of the blood stream for holding in solution the waste products of nitrogenous metabolism, the results of functional activity in the body, is determined by the alkalinity of the blood plasma. Any decrease in this diminishes its solvent power for these, and causes their precipitation in the tissues nourished by the blood stream. This lessened alkalinity may be general, affecting the whole sanguinary current, or it may be localized in certain tissues; in the latter case there will be a localized precipitation of the products of which uric acid is a type. Excessive work causes an increased blood supply to a part, and excessive oxidation and tissue waste, which in turn produce lessened alkalinity, or a tendency toward acidity. The ligamentous tissues are especially liable to conditions of this nature, and the peridental membrane, belonging to this category, is especially subject to affections of the character noted. Excessive work being put upon the investing membrane of any tooth, through malocclusion or by bad habits in mastication, by injuries from wedging, the application of ligatures, or other causes, the resulting hyperemia brings in its train overnutrition, localized diminished alkalinity, with the consequent deposition of urates.

Professor Kirk believes that changes identical with or analogous to those cited above are responsible for other local necrobiotic degenerations. They may be the exciting cause of alveolar abscess, through a diminishing of local physiological activity and lessening of the resistant power of the tissue, which, being infected, leads to suppuration of the pericementum, that has been variously denominated pyorrhea alveolaris, phagedenic pericementitis, or suppurative alveolitis. Under certain other definite conditions the pathological changes may result in a hyperplasia of the tissues, and hypercementosis and hypertrophies of the pericemental membrane may be the result.

It is, then, accepted that this calculus is and must be derived

from the blood, through the pericementum. Certain it would seem to be that the trouble is not in the tooth itself, for the cementum does not appear to be affected in any way, further than secondarily through the mere mechanical separation from it of the pericementum. One reason for supposing that it is not due to a constitutional dyscrasia, that it is not a manifestation of a general disorder, but rather a symptom of a local degeneration or disturbance, is found in the fact that it is usually confined to one or two teeth.

The early presence of sanguinary calculus is not easily determined. Salivary calculus exhibits itself unmistakably to the eye, and so there can be no error in its diagnosis; but such is not the case with the sanguinary concretion. It is hidden within the tooth socket at a point where examination is impossible. No special prophylactic measures can therefore be employed. There may be a localized inflammation, with pustular swelling, but this comes too late for preventive measures. When a pocket reaching down to the deposit has been formed from the gingival margin, there is nothing left but its instrumental removal.

There are instances in which pericemental irritation and soreness may, to the expert, give some warning of nodular formations. But these are too easily confounded with those which may be caused by hypercementosis, or by the presence of any other foreign substance, to afford a positive pathognomonic sign. When we comprehend the morbid changes of the disease better perhaps we will recognize premonitory indications, but, as it is, we must wait for its development. The usual revelation will come through the formation of the characteristic pockets beside the affected tooth, and the point of irritation, when near the apex of the root, may in some instances be detected by the localized inflammation and swelling. The local treatment for the condition is laid down in the chapter on Pyorrhea Alveolaris.

CHAPTER XXX.

PYORRHEA ALVEOLARIS.

Pyorrhea Alveolaris has been defined by Kirk as a necrotic, suppurative, inflammatory process which destroys the pericementum, and by setting up an osteomyelitis in the alveolar margins subsequently destroys them also. He believes it to be caused by the invasion of certain pathogenic organisms which are the exciters of the inflammatory process. The depth of the bacterial invasion determines the seat or location of the inflammation, and is conditioned upon the degree of vital resistance of the tissues invaded. Given low vitality in the pericemental membrane, the invasion is deeper, and the pyorrhea is established by the breaking down of tissue and the establishment of a pocket through the working out of the products of the inflammatory action at the gum margin. Given high vital resistance in the pericemental membrane, the disorder produced by these inciters of inflammation becomes superficial; that is, ulcerative in type.

The depression of vital resistance may be either constitutional or local. If the former, it is brought about by a chronic toxemia, the result of auto-intoxication caused by malnutrition and the imperfect elimination of the waste products of tissue consumption and repair. These toxic substances in the blood stream are irritant in character, and manifest their action in the pericemental membrane by the production of hypercementosis and by other changes. When the predisposing factor is purely local, as in the case of salivary calculus impinging on the gingival margin, the depression of vitality is entirely superficial, affecting only the layer of cells in contact with the calculary deposit. The invasion of pathogenic germs is also superficial, the high vitality of the healthy tissue beneath preventing deep invasion, and the type of the necrotic and inflammatory process is ulcerative.

It is not a matter for boastfulness that for so long a time so little should have been positively known concerning a disease that, after caries, is responsible for the loss of more teeth than any other. It is but recently that any attention whatever has been paid to it. For many centuries it has been doing its destructive work without

remark and without any attempt to determine its pathology. Not alone in man is it prevalent, but many animals suffer from its ravages. Domestic cats are especially liable to its attacks, while dogs are far from exempt. Horses sometimes suffer extremely from pyorrheal affections, but their teeth are not as often extruded and lost, because of the length and shape of the roots, which do not end in a closed foraminal opening. None of the teeth of persistent growth in the various orders of animals are materially affected by these disorders, so far as the author is aware. But he has in his possession the skull of an African gorilla, an animal that it has been found almost impossible to keep in captivity, in which the characteristic appearance of this disease exists unmistakably.

The condition has been known by various names. The late Dr. J. M. Riggs, of Hartford, Conn., was probably the first to call public attention to it, about the year 1850. For some time it was called from him "Riggs's Disease," but the impropriety of this being manifest, the term Pyorrhea Alveolaris was proposed, and has been generally accepted. Prof. G. V. Black has denominated it "Phagedenic Pericementitis." Dr. J. N. Farrar has proposed the name "Loculosis Alveolaris," from the fact that, very often at least, it has its origin in a kind of pocket beside the alveolus. Others, recognizing a communicable nature, have denominated it "Infectious Alveolitis." When its true nature and exact pathology are more fully ascertained, a term that is descriptive of it will undoubtedly be universally accepted. In the meantime Pyorrhea Alveolaris, which signifies a discharge of pus from the alveoli, although somewhat indefinite, is as applicable as any.

It has been intimated that the exact nature of the disorder has not yet been decisively determined. At least no exposition of it has been commonly accepted. Many theories have been offered, and some of exceeding plausibility are now before the dental profession; but, so far, none has received that general acceptance which excludes all other hypotheses. That its seat is within the alveolar socket is easily demonstrated, and that either the tooth root or its investing membrane is an essential factor in its existence is quite plain, for extraction always affords a radical cure. Beyond this there is no admitted certainty concerning its etiology. Professor Black believes the initial point to be in the pericementum. Others have held that it commences with a degenerative condition of the

investing margin of the alveolar process. Prof. W. D. Miller says that there are three active factors in its production: constitutional diathesis, local causes, and micro-organisms.

Perhaps the hypothesis that has attracted the most attention up to this point is that which has been so strenuously urged by Prof. C. N. Peirce and others, that it is but an expression of the uric acid diathesis, and is closely allied to gout, rheumatism, and allied disorders. It has been asserted, indeed, that it is always connected with them, either as a forerunner, a successor, or a substitute. It has been argued that as urea is the effete product of the using up of tissue in functional activity, which the excretory organs should eliminate, its presence in the body is an indication of inactivity on their part. It is undoubtedly true that such effete matter must, from its very nature, by its continued presence excite a more profound influence than would any innoxious foreign substance. We all know the extreme violence and general character of the protests of all the tissues of the body against its presence when manifested in uremic poisoning.

The dense, hard, dark-colored nodules sometimes found upon the roots of teeth, and which are considered in Chapter XXIX., dealing with salivary and sanguinary calculi, it has been claimed are induced by and contain the urates of the blood, and are prime factors in inducing the pyorrheal condition. Could these assertions be substantiated as indisputable facts in all cases, they would be conclusive. But it is urged in answer that it is not positively demonstrated that the concretions referred to have their origin in the blood, that they are necessarily an expression of the uric acid diathesis, that they invariably contain any uremic salts, are at all essential to the pyorrheal condition, or are in any considerable proportion of instances the cause of it. They point to the fact that while they may be frequent or even usual concomitants, pyorrhea exists in its worst form without the presence of any such deposits, and quite unconnected with either gout or rheumatism. In the midst of this conflicting mass of evidence the only sure conclusion at which it is possible to arrive is that the subject has not yet been sufficiently considered, and that we have not verified ultimate facts. There is abundant cause for investigation and observation, and every real student should strive to add something to the knowledge of the subject, until enough has been learned to form a basis

on which to build an hypothesis that shall be unassailable. Some patient investigator will yet solve the problem, as Miller gave us the solution of that of dental caries, which was for so long a time in the same unsatisfactory, unsettled, disputed condition. In the meantime it only remains practicable to present as clear an exposition as the present state of knowledge will permit.

CHAPTER XXXI.

PYORRHEA ALVEOLARIS (Continued).

True Pyorrhea Alveolaris should be a manifestation of some distinct, perhaps specific, pathological condition. The term itself, while expressive of our present knowledge, is too broad, covering altogether too much, for there are many exudations of pus from the alveolar walls that are easily explainable, and of very simple origin. But until its exact nature is distinctly marked out, and all its phenomena comprehended, we must recognize at least three separate pathological degenerations that are covered by the term, and which without doubt are often confounded with each other.

The first of these will be entirely local in its character. It will have its origin in an easily comprehensible cause—local irritation.

The second will have its etiology in deposits of a hard, nodular character upon the roots of the teeth. It will be distinguished by the formation of distinct pockets within the alveolus.

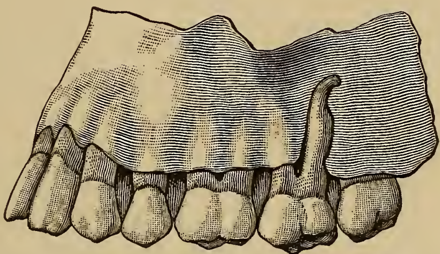
The third will give evidence of some distinct cachectic condition or dyscrasia. It will present phenomena that are peculiar to itself, and will be without either of the two previously named factors.

The first condition is a localized gingivitis, with possible alveolar caries, or a slow solution of the alveolar edges. It is characterized by inflamed, turgid gums, which are everted at the cervix. There will probably be a degenerate mucous secretion of a viscid character and acid in reaction. The gum is not adherent to the teeth, and the point of an instrument can be passed between them. Instead of the hard, dense appearance that the gingivæ usually present, they bleed at the slightest touch. A little pus can be forced out

from between the gum and tooth, but it is small in quantity and thick in consistence. The patient gives the teeth but little care, and they usually present anything but a healthy appearance. The redness is principally confined to the gum margin, and there are few or none of the peculiar red blotches higher up that are indicative of pericemental inflammation. An explorer cannot be passed up far beneath the gum, and, with the exception of roughened edges, the alveolar process is perfect.

The prognosis of this condition is always good. The first care should be thoroughly to clean the teeth, and to remove from about their necks, especially from beneath the gums, any foreign substances that may have accumulated. Not infrequently delicate

FIG. 41.



GINGIVAL DESTRUCTION OF THE PERICEMENTUM WITH RESORPTION OF THE ALVEOLAR BORDERS, DUE TO PYORRHEA OF THE THIRD VARIETY.

There are no deposits and little if any suppuration. The destructive process has entirely denuded one root, and the alveolar walls inclosing the others are very thin. (Burchard.)

rings of salivary calculus will encircle them close up to the alveolar border. All traces of this must be removed, and the necks of the teeth be carefully polished. Sometimes foreign substances, like slivers from wooden toothpicks, or spiculæ of bone from the food, will be found driven beneath the gums, and these will be the source of irritation. After careful cleaning the gums should be well rubbed, and a soft tooth-brush, with some antiseptic wash, should be prescribed. Listerine is good for this purpose, or any of the pleasant essential oils, largely diluted. Care and cleanliness, with the removal of every foreign substance, will be sufficient to produce a cure, for the condition was only the result of a lack of attention, and the irritating presence of foreign substances.

The second condition is one of greater moment. It is charac-

terized by the presence of deep pockets in the alveolus, at one side of the anterior teeth, or perhaps between the roots of the premolars or molars. There may be little of the turgidity or tumefaction described in the previous paragraph, but an exploration with an instrument will detect a resorption of the alveolar walls of the tooth socket, and pus may be forced out. Often the tooth, especially if it is one of the six anterior ones, will commence an inclination away from its neighbor. It loses its upright position, perhaps falls out of the line of the arch, and the previous regularity of a well-ordered dentition becomes sadly broken. The affected tooth is always deflected from the side on which is the pocket, and not toward it. A more careful exploration of this pocket will usually detect, well up toward the apex, or along the body of the root, dense, hard, gritty nodules, that are closely attached to the side of the root, enveloping more or less of the surface that has been denuded of its pericemental membrane, but which is yet covered by the gum. These are the sanguinary deposits described in a previous chapter.

Whether these are the cause or the result of the diseased condition has formed a fruitful subject of discussion among etiologists. Those who believe them to be deposits from the fluids of the mouth insist that there must be some connecting opening between them and the oral cavity, along the side of the tooth. But competent observers have described instances in which there absolutely was none. One such case fell within the observation of the author. His associate in practice found opposite the lower third of the root of a lower central incisor, in the mouth of a woman who took excellent care of her teeth, a peculiar swelling that had somewhat the appearance of incipient alveolar abscess, but which had none of the other symptoms that attend that disorder. The author counseled pursuance of the expectant plan, and waiting for developments. In a very few days pus gathered in a comparatively small amount, and was discharged. The opening was enlarged, and opposite it were the characteristic nodules of the so-called sanguinary or serumal calculus. Yet the gingivæ were absolutely unbroken, and there was not the slightest indication of irritation about the neck of the tooth. The nodules were carefully removed, the opening antiseptically dressed, when it healed, leaving no sign whatever of the lesion, nor has any since appeared. If the hypothesis pre-

sented on a previous page is accepted, the presence of these nodules is accounted for. But there were in this patient no indications of either local or general anemia or lack of tone, while the tooth was one of a nearly perfect set, a lower incisor, not subjected to unusual strain or labor. Upon removal of the calculus it returned to a normal condition, and has so remained for some years.

It must be accepted that, in some instances at least, the serumal nodules are the first indications of the disturbance. Whether these are the result of any special diathesis we need not now further inquire. We know that they are specially irritative in their nature. If they form the initial point of the disorder, the subsequent pathological changes may be easily comprehended. They lift the pericementum from the tooth, and by their presence originate the breaking down of tissue. Infection follows, and the pus forces its way to the gingival margin, thus making an opening into the pocket already formed. Or perhaps the pocket is completed by the continuation of the deposits to the gum margin, the infection being subsequent to this. Perhaps, in a proportion of the cases, the deposition of the calculus commences at the neck of the tooth and proceeds toward the apex, forming the pocket from the margin instead of from the interior of the alveolar socket. In any case, there must be organic or functional degeneration of the pericemental membrane as the immediate or proximate cause of the disturbance, and the attention of the practitioner should be directed toward such local or constitutional remedies as will prove effectual.

The prognosis of this condition depends upon the ability completely to remove the deposits, and upon the general tone of the system, or its ability to bring about a restoration of the lost tissue, and a healthy tone in that which remains. The first remedial measure is thoroughly to cleanse the teeth and pockets. This must be the work of time and patience. If the disease has extended so far as to induce much soreness and looseness of the tooth, it cannot be accomplished without considerable pain. So dense and closely attached is the deposit in many cases that a sharp, stiff chisel, with considerable force, is demanded. The drawing motion of a scraper is insufficient. Only the thin edge of a chisel will reach the last particle, which may lie just at the point of separation of the pericementum from the tooth.

There is no chemical agent that can be depended upon to dis-

solve the deposits away without injury to the surrounding bone and tooth. The usual mineral acids attack the latter quite as readily as the concretion. Trichloracetic acid has been found of benefit in softening it, so that it may more readily be removed with instruments. This may be used in from twenty to fifty per cent. aqueous solution, the exact strength to be determined by trial. It should be carried to the extremities of the pocket on a narrow, wedge-shaped piece of orange wood that has been dipped in the solution, and by a pumping motion continued for a sufficient length of time every nodule may be saturated with it. Or it may be carried upon a rope consisting of a few fibers of cotton wet with the acid. Dr. W. J. Younger, who has made a specialty of the treatment of pyorrhea, uses and recommends lactic acid for the same purpose, and claims that it has special therapeutic value in this disease.

It may be necessary to repeat the operation more than once, carefully chiseling or scraping off all that is practicable each time, until the root is clean and polished. The pockets should be washed out and treated antiseptically. Finally, when all the deposits are removed, a weak solution of chloride of zinc may be injected as a stimulating astringent. It may be necessary to freshen the alveolar edges with a hoe excavator, or a safe bur, to induce new granulations. When there has been an effusion of coagulable lymph it should be protected, and not carelessly wiped or washed away. To this end it is necessary to know when to stop active surgical or operative measures, and to leave the rest to the *vis medicatrix naturæ.* Pursuing this course, the author has had the great satisfaction of seeing pockets that reached almost or quite to the apex of the root, and into which a considerable quantity of cotton could be packed, completely healed and filled with a new growth of bone through the action of a newly-formed pericementum.

The prognosis of the third condition is almost invariably bad. It seems to be connected with some vicious constitutional condition that prevents eradication of the disease. There is frequently very little if any gingival inflammation. There is no thickening or tumefaction, and but little redness of the gums. Perhaps they may even be abnormally pale and bloodless. There are none of the pockets of the preceding conditions, but there is a steady wasting of the alveolus, a continual recession of the gums, with

a constant and sometimes profuse discharge of pus from the sockets of the teeth. In the pocket form a single tooth may be affected, but in this state it usually spreads from tooth to tooth, until all or nearly all of either or both jaws become affected. There is no special pain, or any great degree of soreness until the later stages are reached, when the loss of the teeth seems imminent, and when the destruction of tissue goes on with such rapidity that it almost assumes the acuteness of alveolar abscess.

There may be no deposits of any kind. The condition may occur in the mouths of those who are fastidious in the care of their teeth, and who regard its insidious but sure advances with horror. They fight it with every weapon at command. They may retard it for years, but it is seldom that it is entirely eradicated. The author has under his care cases in which it manifested itself twenty-five years ago, and though it has been kept in check, sometimes by the most radical measures, it still crops out occasionally, and he and his patient have never been long entirely separated.

When a radical cure of this form of the disease has been effected, it has usually been because of some constitutional change in the general tone of the sufferer. It has ever been prone to attack anemic and atonic persons, though it is not confined to them, and when it has been eradicated it has been accompanied by a complete change in the bodily health of the patient, and a return to a tonic state.

The treatment of this special condition must, to a considerable degree, be general in its nature. If it is due to a want of eliminative power in the body, it may be that a prolonged course of alterative and tonic treatment will be necessary to enable the system to recover and maintain its normal tone. If there is any distinct diathesis with which it may be connected, that should be attended to. Antiseptics must be constantly used, and the mouth kept as free from putrefaction as possible. Stimulating, astringent mouth-washes should be frequently employed, and every hygienic precaution exhausted. The space between the gum and the tooth should be kept clean, and whenever necessary it should be wiped out with some mild cauterant, like lactic or trichloracetic acid. Massage should frequently be employed by rubbing the gum with the ball of the finger, using considerable force. The tooth-brush should not be too harsh, and washes rather than powders should be employed with it.

In some instances the author has seen what he thought to be good results following the use of anti-gout and rheumatic remedies. The employment of lithia in some form, or of salicylic acid, has been especially recommended. Dr. E. C. Kirk has reported excellent results from a persistent use of lithium bitartrate, in the form of tablets.

If a tooth becomes very loose through destruction of the alveolar socket it is usually best to remove it, but when it is the result of an acute inflammatory stage, it may be held firmly for a time by weaving a ligature about it and the adjoining teeth. Sometimes there may be a decided amelioration following the burring away of the diseased edges of the alveolar process, with the use of antiseptics and stimulating astringents, but too often this is not permanent. Very little dependence can be placed upon the many specific methods and remedies offered by those who claim to cure the incurable. The best results will be attained by the practitioner who, to general medical intelligence, adds the most faithful, diligent, painstaking care in the line of treatment adopted. Of course, when the whole or nearly the whole alveolar socket of a tooth has been lost, further temporizing methods are useless.

CHAPTER XXXII.

FACIAL NEURALGIAS.

Neuralgias are affections of a nerve trunk or filament, and may be either organic, constitutional, functional or local in their origin. The first of these occur through some organic change in the tissues which renders them incapable of healthy action. The second arise from and are associated with a constitutional diathesis. The third are due to disturbed nutrition and the consequent lack of tone, while the fourth originate in a direct lesion, or in some local irritation. An instance of the first is the pain due to cicatrization of a wound; of the second the general neuralgia of gout or syphilis; of the third that of miasmatic affections, while the fourth may be found in prolonged dental disturbances. Strictly speaking, any pain is a neuralgia, but the usual signification is confined to an affection in a nerve trunk as distinguished from that caused by irritation of a terminal filament. The continued pain arising from

a neuromatous tumor is an instance of neuralgia from a true lesion of a nerve trunk.

True neuralgias are principally confined to the afferent nerves, but they may be reflex and hence have their origin in the efferent or motor nerves. The facial neuralgias that form the majority of the affections presented to the notice of the dentist are manifested in the trigeminus, and their most frequent cause is diseased teeth. The irritation from caries may be so severe, or so long continued, that the trunk of the nerve is affected and its function so modified that it remains in a permanently irritable condition.

The diagnosis of this disorder is not always easy. That is, it is sometimes difficult to determine whether the pain arises from a mere local irritant, like the inflamed pulp of a tooth, or if it is a true degeneration or functional disturbance of the nerve tissue. In facial neuralgia the first thing to do is to look for the cause, and to determine whether it may not be mere odontalgia, or toothache. To this end the most minute examination of the teeth upon the affected side should be made. Cavities may exist beneath the gums which only the most careful search will reveal. Every test for inflamed and irritated pulps should be tried, and in the great majority of instances the suspected neuralgia will be found to be mere toothache.

Every local cause having been excluded, the general bodily condition should be noted. If any distinct diathesis exists, like that of gout, rheumatism, syphilis, malaria, or catarrh, its possible connection with the disturbed neural currents should be looked for. If there is a state of anemia, or lack of nutrition, here may be its origin. The starved nerves are loudly crying for the sustenance they lack.

All these sources excluded, a neuroma, or some other disorganization of the nerve tissue itself may be suspected. When this is the case and a true neuralgia is indicated, more minute inquiries should be made as to the character of the subjective symptoms.

If neuralgic, the pain will be unilateral. Though not local, it will affect but one side, for bilateral disorders of this kind are something more than rare.

The pain will usually follow the course of the trunk of the disturbed nerve. That is, it may be recognized at different points in the route.

It will be sudden in its attack. Its onset will not be a gradual approach, increasing in intensity until the climax is reached and then subsiding by degrees, but, from entire ease, instantly the victim is in the throes of the most agonizing torture.

It will be of a darting, stabbing, boring character. It is not the steady, dull, throbbing, continuous pressure of a pus gathering.

It will be markedly intermittent. There will be intervals of complete immunity of greater or less length succeeded by paroxysms that will end as suddenly as they begin. There may or may not be regularity in these attacks.

In the earlier stages there is usually an increase in severity with each paroxysm, to be succeeded by decreasing violence. While the invasions are sudden in their attack and subsidence, there is a true paroxysmal character to their recurrence, each one becoming more severe until the climax is reached, when the abatement will be as gradual.

There is no functional disturbance connected with the attacks. The pulse will not be accelerated, nor will the temperature rise. There is no fever or other general disturbance. This is an important pathognomonic symptom.

In some instances, especially in cases of long standing, there will be soreness along the track of the affected nerve. This may be especially marked at the foramen of exit. Anesthetic spots in the tissues supplied by the disordered nerve may assist in the diagnosis.

Reflex symptoms in communicating nerves may be exhibited. There may be spasms and muscular twitchings. Tears may flow, the effect of reflex irritation, or salivary secretions may be markedly increased.

Fatigue and depressing influences bring on invasions, or exacerbate them. The receipt of distressing news will possibly provoke an attack. Sleeplessness or any unusually prolonged exertion will be likely to be followed by paroxysms.

The clinical history is usually quite distinct and marked. Neurotic persons, and those with an unbalanced nervous organization, are especially liable to attacks. Hence the neuralgias are frequently closely related to hysteria, migraine or sick-headache, hypochondria, paralysis, catalepsy, epilepsy, and other nervous and convulsive disorders. Clavus hystericus is but another special form of it.

It usually accompanies or indicates an atonic, debilitated condition. It is sometimes among the sequelæ of a long-continued fever or other exhausting disease.

It is especially liable to attack those who are suffering from malaria or miasmatic fevers. In such instances it sometimes assumes the form of "brow ague."

The gouty and rheumatic diathesis seems especially provocative of different forms of neuralgia. Among these, sympathetic affections of the trigeminus, or fifth cranial pair, are not uncommon. Indeed, sympathetic pains along the course of communicating branches or nerves, or through those but secondarily connected by different ganglia, would naturally be anticipated from the very nature of the disorder. It could not well be otherwise than that reflected pain would be felt in perhaps distant tissues or organs. These may not be of a severe character, and they will probably be felt at the outset, or more likely still at the close, of a paroxysm. Yet their existence may be an important part of the clinical history, and should be carefully sought out.

Treatment.

A real neuralgia having been clearly diagnosed, the first thing will be to determine its cause and to remove it. If there is any local source of irritation it must be remedied.

The hygiene of neuralgic patients should be carefully looked to. They must be guarded from sudden changes of temperature, draughts of cold air, etc. All sanitary precautions must be adopted, and if the patient suffers from malaria removal from the miasmatic influence is the first consideration.

Plenty of out-door exercise must be urged, with a liberal, rather stimulating diet. Extreme fatigue should be guarded against, and bodily and mental rest is important.

If there is a constitutional or general functional dyscrasia, it must be relieved. Nervous sedatives may be prescribed, and general quiet insisted upon.

Potassium bromide, ten grains in water, from two to ten times per day, will be found useful, or tincture of valerian and gentian, equal parts in teaspoonful doses. During the paroxysm, digitalis, or veratrum viride in five-drop doses may be given, and aromatic spirits of ammonia in fifty-drop doses will be found useful.

If there is a gouty diathesis, wine of colchicum in small doses, frequently repeated if necessary, should be prescribed.

Muriate of ammonia fumes, arising from the burning of the salt upon a hot iron in the room, sometimes give gradual relief.

If the neuralgia is of miasmatic origin, from three to ten grains of quinine should be administered, or Fowler's solution of arsenic and potash in ten-drop doses, two or three times per day.

Hot moist applications to the affected parts are very useful, and massage sometimes gives very ready relief, although there are instances in which it will be found exacerbating. It must be gentle, and not too long continued at first.

If the paroxysms are very violent, it may be necessary to allow the patient to inhale the vapor of ether or chloroform for a short time; of course, not to the point of entire narcosis.

If none of the usual remedies are effective, and if the paroxysms are violent, resection of the affected nerve may be necessary. This will, with comparative frequency, be called for in neuralgia, especially in that of the inferior dental nerve. Professor Brophy, of Chicago, has greatly simplified this operation, and by his method it no longer presents any formidable difficulties. His resections of the infra-orbital from the oral cavity also relieves that operation from many complications.

CHAPTER XXXIII.

FACIAL PARALYSIS.

In its etiology this affection is closely connected with facial neuralgia, but it differs from it in being the effect of lack of nerve nutrition, while the neuralgias are more frequently the result of overstimulation. It is also more frequently due to organic lesions or cachectic conditions. It may arise from syphilis, tubercle in the cerebral centers or cord, or a blood clot in the brain. In any case, it implies disordered nerve function, and its treatment may often properly fall within the province of the oral physician, inasmuch as facial paralysis is not infrequently due to some oral lesion.

Facial paralysis is the complete inhibition of efferent neural currents in the tissues affected, with usually a local anesthesia, or suspension of afferent nerve currents, more or less complete. It may

be traumatic or idiopathic in its origin. If the former, there will be no difficulty in determining the fact, while in the latter case its source will be more obscure. It may be complete or incomplete. It is complete when there is a total loss, and incomplete when there is only more or less of diminution of function in the nerves. It is general when there is loss of power in both the upper and lower extremities, and local when it is limited in the number of muscles affected. Facial paralysis is local in its character, and as seen in oral practice it is usually but partial.

Paralysis of sensation may be either loss of tactile sense—inability to receive impressions from external contact—or immunity to painful sensations. Thus the skin and the mucous membrane of the mouth are endowed with both kinds of sensibility. The capacity of these tissues to receive painful impressions may be quite impaired, or even lost, while the tactile or feeling response to external agents remains. But in these instances the impression made by ice, or a hot iron, will not materially differ from that derived from a piece of wood.

Paralysis of the tactile sense is commonly called anesthesia, while that of the sense of pain is denominated analgesia. Reflex paralysis is a term that has been applied to cases in which a paralyzed condition of certain parts is attributed either to a wound or shock received from other and more or less remote parts, or to a local disease situated elsewhere than in the paralyzed region. Dr. Brown-Séquard supposed this to be induced through shock to the vaso-motor nerves, thus interfering with the nutrition of the nerve centers.

The instances of paralysis that are of the greatest interest to the dentist are those of the fifth and the seventh pair of cranial nerves. The fifth, or trifacial, is the great sensory nerve of the head and face and the motor nerve of the muscles of mastication, while the seventh is the motor nerve of the muscles of expression. Complete paralysis of the fifth nerve results in the loss of sensibility of one side of the face, of the mucous membrane of the mouth, the conjunctival membrane, the anterior portions of the tongue, with the muscles of mastication upon the affected side. The external manifestations are not so pronounced as in paralysis of the seventh nerve, because the resulting deformity is not so great. There is a loss of the special sense of taste, and sensation is absent. But if

the affection is unilateral, mastication may be carried on by the use of the muscles upon the sound side. The tongue and buccal tissues upon the paralyzed side are frequently bitten and lacerated in the act of taking food, sometimes seriously, because the muscles are unable to keep themselves from getting between the teeth, and sensation being gone the patient is unaware of the injuries that are being received. Such paralysis may be induced by long exposure of the face to cold or a keen wind.

Paralysis of the seventh cranial nerve is perhaps not so common as that of the fifth, but it is much more readily observed, as it results in serious deformity. With the loss of function in the nerve all expression in the affected side is lost. In speaking or smiling the mouth is drawn toward the sound side through the loss of contractile power in the muscles of the affected side. The contractility of the orbicularis oculi being absent, the patient is unable to close the eye or to wink. The secretions of the lacrymal gland are not diffused over the conjunctiva owing to the loss of function in the orbicularis, and there is a more or less constant overflow of tears upon the cheek. The saliva dribbles from the angle of the mouth, and the pronunciation of certain letters of the alphabet is interfered with.

Paralysis of the seventh is perhaps most often caused by intracranial disease. These cases will properly fall within the province of the general practitioner. But it may be the result of injury. The extraction of a considerable number of teeth at one time may produce a shock that will cause spasms of the muscles of mastication, or even inhibition of function and paralysis, with jaw drop. The spasm may be clonic (paroxysmal) or tonic (continuous).

The symptoms are too pronounced to be mistaken. There will be a drawing of the muscles of the face, due to their entire relaxation, with a loss of mobility. The eye remains staringly open, and a smile is observable on one side alone. All expression upon the affected side is lost and the muscles are in a state of tonic relaxation. This will be observed by the operator before the patient becomes aware of the lesion. If it is of a clonic character he may by gentle manipulation of the tissues relieve the spasm, or temporary paralysis, and within a few moments have the satisfaction of seeing the muscles regain their tone. Of course he will remove the hand-glass from the reach of the patient to prevent the unneces-

sary alarm and nervousness which discovery would cause, and which would only tend to aggravate the condition. Should the injury be more lasting in its character and assume a tonic form, the dentist should explain to the patient the probably temporary nature of the lesion and commence the proper treatment for relief of the condition.

One of the most effectual remedies for this condition is electricity. The faradic or induced current should ordinarily be used, and it must be gentle at the outset, nor should it be continued too long. The cathode or negative pole should be placed over the cerebellum, and the anode or positive electrode carried gently over the points of distribution of the affected nerve. Occasionally the poles may be changed, and if it is desired to stimulate the facial nerve alone, the stationary electrode may be placed immediately in front of the external auditory meatus, while the other is moved successively over the various terminal branches. This treatment, if found beneficial, may be repeated every day, provided the current is not too strong and not too long continued. At the outset it should not be used so often.

If the disorder has its seat in the ganglia, the magneto-electric interrupted current may sometimes be used with good effect, but it should be employed with caution, because it may still further tend to the inhibition of the neural currents in exhausted trunks or branches.

Massage of paralytic muscles, if mild and properly applied, will be of great benefit in many cases. The facial muscles may be gently manipulated with the balls of the fingers, and rubbed in the direction of their fibers with the palm of the hand.

The hygienic condition must, of course, be carefully looked after, and out-of-door exercise with nourishing food directed. Vegetable tonics may be prescribed if indicated, and quiet and rest ordered. If the paralysis is the result of any trauma, such as the extraction of teeth, the wounds must be carefully examined to see if there are any loose fragments of alveolus or bone left, and all possibly irritating projections and spiculæ should be removed. An aseptic condition must be maintained, and soothing applications applied. With these precautions, unless the lesion is very great, a gradual return of functional activity may be anticipated.

CHAPTER XXXIV.

SYMPATHETIC DISTURBANCES.

The nervous system of the body holds all the various organs and tissues in correlation with each other, and secures harmonious functional action between them. Every organ works, not alone for itself, but for all the rest. There is but one heart to carry on the vascular circulation for all the tissues, but one digestive tract to provide nutrition for all, and but one pulmonary organ to furnish the necessary supply of oxygen. Hence the mutual interdependence is complete, and no tissue or organ can be properly studied aside from its relation to the others. No oral physician, or dentist, is equipped for the practice of his specialty until he can show that he has made himself acquainted with the functions of other organs, and has learned their possible reflex agency upon those with whose care he is especially charged. A fair knowledge of the anatomy and the physiological function of every tissue in the body is essential to the dentist as well as to the general practitioner, and without the basal facts upon which all curative measures must be founded he is as unfitted for his vocation as would be any other man who professes to practice any branch of the healing art. Any disordered condition of one organ affects to a greater or less degree all the others. The sympathy may not be as active in one case as in some others, but it is as certain. The dependence of one tissue or organ upon another may not be as complete or entire as that of others, or as may be the reciprocal reliance, but it surely exists. Proper functional activity of the brain may for some years be more disturbed by indigestion than would ensue to the stomach if the converse were the case, but no physiologist would assert that digestion could be properly and fully performed in cerebral congestion. The gravid uterus of the female will be more deranged by toothache than the teeth will be disturbed by metritis, but each reacts upon the other to the extent of its susceptibility, and their mutual relations cannot be lost to sight.

The organs disturbed by diseases of the teeth and the oral tissues will be those to which they bear the closest relation. It is well known that the teeth sympathize with each other to such an extent that it is sometimes difficult to determine which one, and

sometimes which jaw, is affected. Otitis media may exhibit itself as toothache, while on the other hand pains in the middle ear are very often mere reflexes of odontalgia. The eye sympathizes with the teeth to such an extent as sometimes to exhibit a profuse lacrymal discharge as the accompaniment of toothache, and alveolar abscess may be diagnosed by the condition of the pulse. The otologist especially should be on good terms with the dentist, for mutual consultation is frequently desirable, owing to the intimate relations of the organs concerned.

But the reflex disturbances which most concern both practitioner and patient are the possible complications of pregnancy. Women have long been taught that the relations between the teeth and the impregnated uterus are so intimate that each must vicariously suffer for the other. "For every child a tooth," was a proverb long before the period of modern dentistry. That extraction is very liable to be followed by premature delivery is a part of the creed of every expectant mother. The impression resting in the minds of too many dentists that temporary disturbances may, within a short time, exhibit themselves in a softened or changed condition of the tooth structure, is perhaps responsible for a part of the general belief that the teeth decay to a much greater extent than usual during pregnancy.

It should be remembered that nutritive changes in the dentine are exceedingly slow, while it is not unreservedly admitted that they take place at all in enamel. Hence, while functional disturbances in the teeth are quick to manifest themselves in allied tissues, the reverse is not the case. A continued fever may cause a great waste in many tissues, but it cannot in the teeth, because there are in them no absorbents, no lymph system. There is no active circulation in either dentine or enamel, through which progressive or retrogressive changes may be readily and quickly wrought. The supposed divergence of the nutrient currents from the teeth to the growing child must, then, be largely imaginary, and there can be no sudden breaking down of these organs during pregnancy.

And yet the general impression that the teeth decay more at that time than any other doubtless has some basis upon which to rest. One explanation may be found in the fact that at such times the pregnant woman has something else to take up her whole attention, and often intermits the care that she is accustomed to give

her teeth. Food is suffered to remain upon and between them, and fermentation does its perfect work. The pregnant woman sometimes has perverted or unnatural appetites, and takes into her mouth deleterious substances. Mineral tonics are frequently prescribed for her, and these may bring about destructive results. But there is little doubt that the fact that at least a year passes in which she is usually without the dentist's help is the principal factor in the result attained. Poor people, who never care for their teeth, find little difference between the period of gestation and any other.

The fear that a visit to the dentist must result disastrously is a mistaken apprehension. It is the true office of the oral practitioner to relieve pain, and not to cause it. Every woman who finds herself pregnant should visit her dentist, if he is a competent man, should tell him her condition, and place herself in his hands for such measures as are necessary. He will take special care to avoid giving her pain at such a time, not because it would always be immediately hazardous, but from the necessity for preserving her mental and nervous equilibrium to as great an extent as is possible. If there are cavities of decay that would be likely to bring about complications before the time for her delivery, they should be filled, usually with plastic materials. If there are troublesome teeth, so badly diseased as to forbid conservative measures, they should be promptly extracted. If the administration of a general anesthetic is essential, she should be referred to her medical attendant. If from the performance of any such necessary operation, when carefully and skillfully done, any ultimate harm has ever occurred, it has not been made a matter of record, and the world is in ignorance of it. It should not be forgotten that the pregnant female is usually in a state of exalted nervous sensibility, but that does not necessarily imply that all operations upon the teeth are inhibited.

That there is more toothache during gestation than at other times may be quite true, but there are often sympathetic disturbances, without real tooth lesions, that have their origin in the disordered nervous condition. Concerning the nutrition of the teeth of both mother and child, and the prevailing belief that these can be governed by any specially regulated diet, another chapter will have something to say.

CHAPTER XXXV.

DISEASES OF THE MAXILLARY SINUS.

The position and relations of the Antrum of Highmore, or the Maxillary Sinus, make it peculiarly liable to disorders of a catarrhal nature. There doubtless exist many more such than are recognized by oral physicians. The sinus is a cavity within the superior maxilla, connected by a small opening with the air passages of the nose. It allows proper contour of the face without the weight of bone that would be the consequence of solidity. It also makes the nutriment of the bone more easy, and obviates any necessity for a large medullary portion. But its principal utility is in giving resonance to the voice. All musical instruments have a hollow chamber of some kind, to increase the reverberations and reflect the vibrations of the air. The perfection of the instrument and its quality and volume of tone depend very largely upon the particular form of this reverberatory chamber. Many years of experiment have not been able to devise any beneficial modification of the peculiar shape of the body of the violin, as it was fashioned by Guarnerius, more than two hundred years ago. Any departure from that model, whether accidental or intentional, has been found to change the character of the vibrations and impair the tone of the instrument.

The antrum is the principal sounding-chamber of the human voice, and the wide variations in the character of the tones produced are due in a large degree to the size, shape, and condition of the cavity. The howling monkey, whose voice can be heard at night for several miles, has an additional osseous chamber to reinforce the reverberations of the antrum. (See Fig. 42.) All are aware of the peculiar hard, metallic, unmusical tone that is communicated to the voice in cases of empyema of the antrum, or in atresia of the communicating sinus.

The size and shape of the antrum in different individuals vary as greatly as do the characteristics of the voice. In some it is large, and occupies the whole center of the bone. The two antra in the maxillæ have even been known to be a continuous cavity, united by a communicating opening across the symphysis. Usually, how-

ever, its anterior limit is the canine fossa. It is sometimes partially divided into a number of chambers by septa passing across its floors. (See Fig. 43.)

The opening by which it communicates with the air passages is at the point of junction of the ethmoid and palate bones and the turbinated process of the superior maxilla. This is usually at or very near its highest point. Dr. M. H. Cryer, of Philadelphia, has, by his dissections and studies of the cranial bones, added largely

Fig. 42.

Showing the Resonant Chamber Attached to the Larynx in the Howling Monkey.

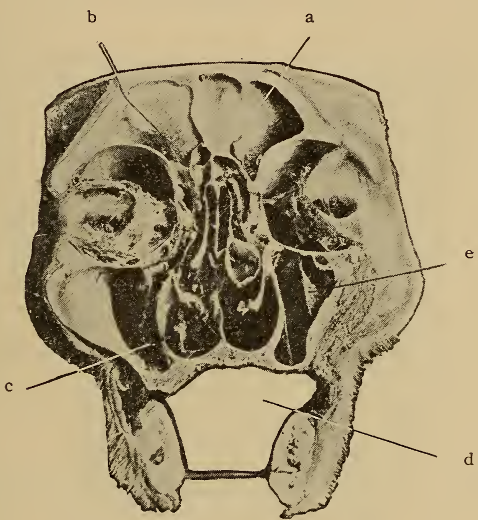
to our knowledge of the structure and configuration of this cavity; and Dr. Thomas Fillebrown, of Boston, has given us yet further illumination.

The commencement of the formation of this cavity is not until early childhood has been passed. Hence antral disorders are unknown in infancy, because there is then no maxillary sinus to become diseased.

The mucous membrane lining the antrum is continuous with the Schneiderian, or that covering the bones and cartilage of the

nasal cavity. It will therefore be liable to the same diseases and be materially affected by the condition of the air passages. Inflammations and degenerations of the Schneiderian membrane, by mere continuity may be communicated to the antrum, and a nasal catarrh may induce a chronic antral disorder. This will be the most fruitful source of the degenerated conditions so often present, and if what has frequently been asserted is true, that in the northern and eastern parts of the United States the person who is entirely free from catarrhal troubles is an exception, it must necessarily

FIG. 43.



VERTICAL SECTION THROUGH THE SKULL.

a, Frontal sinus; *b*, A wire probe thrust into the infundibulum; *c* and *e*, Membranous septa extending across the antra; *d*, The oral cavity.

follow that most of the residents of those sections have disordered or inflamed antra, and this may account for the nasal tone said to be characteristic of their voices.

The roots of decayed and devitalized teeth may sometimes penetrate the floor of this cavity and become points of irritation and of infection. It does not seem probable that any healthy root can actually pierce the floor. The very conditions of the formation of the apex demand its investment by the pericementum, and that being a double membrane its functional activity implies a septum

of bone upon its exterior surface. Accordingly, in the examination of antra it is found that the apex of the root of a premolar or molar tooth that might otherwise be within the cavity is covered with a thin septum of bone that forms a distinct eminence upon the floor, and no tooth that reaches the level of the antral floor is without this. When, however, there is a devitalization of the pulp, with a consequent pericemental inflammation at the apex, the nature of that affection implies an absorption of the bone that forms the septum; and then the end of the tooth might be within the antral walls, perhaps perforating the mucous membrane. Under such circumstances the apical pericementum would be lost, and the root to that extent denuded.

If an abscess forms at the apex, it may discharge into the sinus, but such a condition will not be likely to exist, because there must be investing tissues capable of affording a continuous supply of plastic lymph to form the basis of the pus discharge. As this would not be the case when the apex of the root actually lay within the antrum, penetrating the lining, a chronic abscess discharging into the antrum is not probable. The projecting root, however, could undoubtedly prove a continuous source of irritation to the lining membrane, and thus be the cause of a persistent inflammation, which in due process of time would induce a condition of degeneration of the mucous follicles, with ultimate breaking down of their structure. In this manner the roots of dead teeth may undoubtedly be the cause of actual empyema.

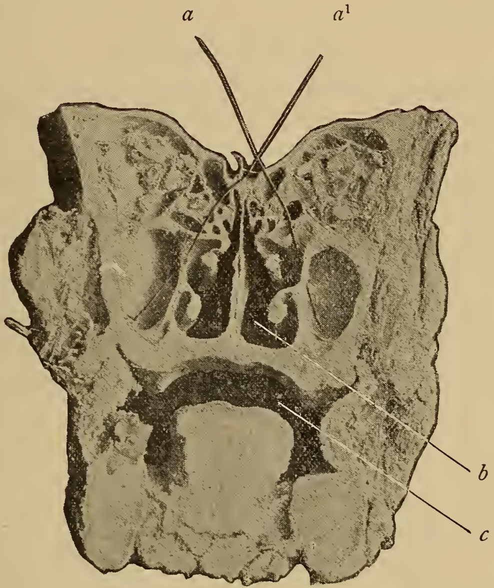
Traumatism is, probably, more frequently than many persons are aware of, the origin of actual degenerations. Teeth are too often extracted with a degree of violence that would never be condoned in the general surgeon. The fact that the alveolar walls are exceedingly vascular, and that injuries are healed more readily than in any other osseous tissue, alone saves the patients of many harsh dentists from most serious consequences. There are more fractures of alveolar walls, even to the depth of the maxillary sinus, than most people would imagine. There are few practitioners who have not seen cases, either in their own practice or that of others, in which a part or the whole of the septa of the molar teeth was removed, making a considerable opening into the antrum.

The presence of foreign substances sometimes induces a diseased condition. Into a cavity, accidentally made, may penetrate

some extraneous matter that will remain a source of irritation, or the root of a tooth may be forced into a cavity in extraction, and as long as this remains the degeneration will be kept up.

It has been demonstrated that the infundibulum, through which the frontal sinus discharges its secretions, in a considerable number of instances at least, opens into the apex of the antrum instead of into the meatus of the nose. Normally, the opening is

Fig. 44.



Vertical Section through the Skull Immediately Posterior to that Shown in Fig. 43.

*a a*¹, Wire probes thrust through the natural apertures into the antrum; *b*, Nasal fossa showing turbinated bones; *c*, Oral cavity.

separated from the mouth of the infundibulum by such a thin septum that it is readily broken down by any diseased condition. In such instances any vicious secretions from the frontal sinus would form the initial point for degenerations in the antrum. (See Fig. 44.)

Whatever their source of origin, the usual phenomena presented by antral diseases are those of disordered mucous membrane. The probable steps in the degenerative process are, first, a

hyperemia, to be succeeded by congestion and suppression of the mucous secretion. Then follows an active state of inflammation, with degeneration of the mucoid follicles, and perhaps a profuse watery discharge. This may continue for a time, when, if the irritation is continued, further degeneration takes place, with final breaking down or ulceration of the surfaces. The mucous membrane thus destroyed, and the periosteum devitalized, there is no longer normal nutrition for the bone, and a progressive caries of this tissue, or even necrosis, with a profuse discharge of pus, will be the consequence.

Symptomatology.

The symptoms attending the early stages of catarrh of the antrum are not very marked or distinctive. There will be a feeling of dryness, with its characteristic pain in the antral region, and possible pressure. The latter symptom, however, more distinctively belongs to a later period. The general phenomena are those of catarrh of the air passages.

These are perhaps succeeded by profuse watery secretions, which may quite fill the antral cavity and produce that feeling of pressure and the changes of voice that are so often observed in acute coryza. This will pass away with the other prodromata of empyema.

Finally, the repeated attacks of the acute inflammatory process are succeeded by a continuous, chronic condition, and function is permanently impaired. This leads to structural degenerations in the mucous follicles themselves; they break down and an ulcerative surface succeeds, and thus an empyema is established. Pus may be formed in such quantities that the antrum is filled, with complete atresia of the natural opening, and a distressing distention is the result.

The feeling of pressure under such conditions will be severe. There will be the usual septic fever, and the superincumbent tissues will be hot and irritable. If this breaking down of the tissue and the formation of pus continues, there will be dilatation and protrusion of the antral walls at their weakest point. This may be in the orbital region, and the eye may be actually forced partly out of its socket. It may be at the basal walls, in which case the protrusion will be above the roots of the teeth; or it may be at the palatal processes of the maxillary, and the protuberance be into the oral cavity.

The general symptoms will be nearly the same if the origin of the disorder is other than that of nasal catarrh. If the frontal sinus is diseased, and its depraved contents are discharged into the antrum through a misdirected infundibulum, the prodromata will be more brief in their course, but the pathological changes will not materially differ. The same may be said of the presence of foreign substances in the sinus. The character of the changes will be those that are usual in inflammations of mucoid surfaces.

CHAPTER XXXVI.

TREATMENT OF DISEASES OF THE MAXILLARY SINUS.

The prognosis is usually good, provided all sources of irritation can be removed, and, as in all inflammatory processes, the first attention should be paid to this point. If the trouble is taken in its early stages of simple catarrhal inflammation, the usual remedies for that affection should be employed. Nasal douches of erethymol, listerine, or borolyptol, diluted with from three to five volumes of water, may be frequently used for irrigating the nasal mucous membrane. If these cause pain, a little cocain may be added. For the ordinary colds, that seem likely to run a chronic course, with first a dry, heated condition of the mucous membrane, followed by a muco-purulent discharge, the following may be used:

℞—Borolyptol,	℥j;
Cocainæ hydrochlor.,	gr. ij;
Aquæ dest.,	℥iij.

Sig.—Use as an irrigating douche.

In the acute stage of coryza the following will be found useful:

℞—Acid. carbolici,	ʒ⅛;
Alcoholis,	ʒij;
Aq. ammoniæ fort.,	ʒj;
Listerine,	ʒiij.

Sig.—Pour half a teaspoonful into a cone made of blotting-paper and inhale.

In addition, for the relief of the antral congestion, a saline cathartic may be given, its operation to be followed at bed-time by one-sixth to a quarter of a grain of sulphate of morphia, dissolved in an ounce of acetate of ammonia liquor.

With relief for the catarrhal inflammation the antral complica-

tion will pass away. **But if there is any filling up of the sinus, either hydromatous or empyemic, it must be opened.** This is accomplished by penetrating the walls with a trocar. To obtain perfect drainage it is absolutely essential that this be done at the correct point, otherwise some of the cavity will continue to be bathed in the vitiated fluid. Usually the lowest depression is found just anterior to the first molar tooth, but this is by no means universally the case. Sometimes the antral cavity does not reach anterior to this, and occasionally it lies considerably farther forward. If the thumb and finger are made to grasp the alveolar and palatal processes, and the oral region thus carefully examined, one may be able to determine the point at which the divergence of the walls marks the beginning of the cavity.

If the first permanent molar has been removed, the best place for making an opening will be at that point. If it be much decayed it will be wise to extract it and drill or puncture through the socket of its lingual root, as the floor of the antrum is lower on the lingual than on the buccal side. Care must be taken to avoid following too far in the direction of the root if it diverge much from the others. The drill, or trocar, should be pointed in the proper line. The best instrument is a twist drill in the dental engine. The cavity once reached, the aperture should be expanded with a reamer until it is at least as large as a common lead pencil. An opening less than this will be likely to become closed. It is not usually a formidable operation, or one attended with a great deal of pain, but in most instances it will be advisable to administer an anesthetic.

The opening once made, a little time should be given for its drainage, when it may be washed out with tepid water in which a little salt has been dissolved, thrown into the cavity with a syringe. This may be repeated until the cavity is quite clean, when a disinfectant, like peroxide of hydrogen or electrozone, warmed to blood temperature, may be substituted. Care should be taken to dilute it if peroxide of hydrogen is used, for if much pus remains, and it be injected pure, or nearly so, violent and painful foaming may be the result.

If the opening is of sufficient caliber and made at the lowest point very little treatment will, in cases uncomplicated with discharges from the frontal sinus or foreign growths or substances, be demanded. The antrum should be thoroughly washed out with

tepid water before medicinal agents are introduced. A disinfectant simply decomposes septic matter, and there is necessarily nothing therapeutic in its nature aside from this. It is better to wash out the pus than to decompose it, for its elimination will be more perfect and more readily brought about, provided the opening is completely patulous.

The cavity having been cleansed, the next step will be to secure continual drainage. For this purpose the insertion of a drainage tube has been recommended, but this, it is believed, will seldom be found necessary, and there are conclusive reasons for its rejection, if that be possible.

The drainage tube that has usually been employed is of metal, and is attached to some convenient tooth by a clasp. It is very difficult to retain in position one of any other kind, because adhesive plaster bandages, and the methods by which such are usually held, are inadmissible in the mouth. A metal drainage tube must of necessity act as a continual irritant and become a focus of inflammation and of infection. It is almost impossible accurately to adjust its length, and if it should once be perfectly adapted it will not remain so. If the upper end projects above the floor of the antrum it will not afford perfect drainage, and if it does not it will fill and become stopped with granulations more readily than an opening without such a tube, because its irritant presence will stimulate hyperplastic growths.

It will seldom be the case that a drainage tube will be needed if the opening is sufficient. Should the mouth of it not remain patulous, the granulations should be cauterized or cut away. This will be better for the disorder than to allow them to grow about a drainage tube. If the orifice is kept dehiscent, open and gaping, the drainage will remain perfect, and the diseased condition will not be perpetuated by retention and further degeneration of the septic product, even for an hour.

Tents and plugs for the perforation should be avoided. They are an irritation, retaining within the antrum the septic products that should be removed or allowed to escape as soon as formed. Even a moment's restraint is evil in its tendency. The sole excuse for their employment is that they prevent the entrance of food, saliva, etc., from the mouth. There is no cause for anxiety from this source, for saliva will not enter against the force of gravitation,

while food and *débris* can only penetrate when forced in, and they are usually spontaneously eliminated before fermentation can take place. But even if there is a liability to the intrusion of foreign matter through an unstopped orifice, the possible resulting injury could not be as great as that arising from an impeded drainage. If the natural foramen of the antrum is closed the artificial opening must be kept unstopped, because communication with the outside air is a necessity. As well might one seal up the drum-hole as entirely to close the antrum, which, as has already been said, is a reverberatory chamber.

The employment of tents and plugs has resulted in very serious injury at times. It will doubtless have been found by most oral surgeons who have had a considerable experience in the treatment of antral disorders, that the most obstinate and incurable cases were those in which a comparatively small aperture had been made, with the subsequent attempt to keep it open by tents, distenders, and drainage tubes. It has become the common usage of those who have acquired skill by extensive practice in these cases, first of all, carefully to explore the antrum for lost plugs and dressings, or parts of such, which are certain to perpetuate the disease. Any oral surgeon can call to mind more than one instance of this. The author has never met with a case of persistent antral degeneration, in which it was possible to remove the source of irritation, which was not healed with comparative readiness if drainage was left free and unimpeded. He has frequently met instances in which no relief was obtained until a dressing or other foreign substance that had lodged in some depression in the floor had been found and removed. In one case it was a piece of iodoform gauze more than six inches in length.

Perfect drainage having been secured, there are comparatively few cases that will demand anything more. The use of the drastic and irritating remedies and solutions that are so frequently injected is to be avoided. Cleanliness once assured, the *vis medicatrix naturæ* will usually do the rest. A considerable number of instances from daily practice might here be cited, in which a profuse, long-continued, and exhausting empyemic discharge was entirely cured by a proper operation, the permanent removal of all tubes, plugs, tents and dressings, and a thorough washing out and disinfection of the sinus.

The irregularities in the shape of some antra insure the indefinite continuance of the septic state unless some further surgical interference than the mere perforation of the floor is provided. Occasionally septa will be found crossing the cavity, and dividing it into partially separate chambers. Depressions in the base will be encountered, which will retain septic matter. If the opening has been made sufficiently large, a bent silver probe may be used to explore for any laminæ and dividing walls, and for intrusive foreign substances. When their nature will permit, any septa should be broken down, and when this is not practicable the patient should be directed occasionally to incline the head in such a manner that any retained fluids may flow out toward the drainage opening. Care should also be used frequently to wash out such depressions and partial chambers, and to keep them thoroughly disinfected. (See Fig. 43.)

The author has in some instances found it impracticable to make an opening sufficient for all this work through the floor of the antrum, and has broken down the external walls until the end of the finger could be introduced for exploratory purposes. Such an aperture gives entire access to every part of the sinus, and enables the operator to determine the presence of necrosed conditions, and to extirpate dead tissue, if it be not of too great proportions. General surgeons usually open through the alveolar walls just posterior to the canine fossa, claiming that an orifice sufficient in size cannot well be obtained at any other point.

There will be instances in which, from a general atonic or anemic state, some cachectic condition, or special degeneration like necrosis, there is not a speedy return to health. The inflammation may assume a low, subacute, or chronic stage, and the indolent tissues refuse to respond to the treatment indicated. In such cases more rigorous measures must be inaugurated. After disinfection a solution of three to five grains of chloride of zinc to the ounce of water may be injected, and made to reach every part. This will act as an antiseptic and a stimulating astringent, and probably bring about an altered condition. If it be insufficient, it may be used in still stronger proportions, the production of painful and irritating symptoms being the guide for its limitation.

If there is pain, it may be treated by an injection of dilute wine of opium. In case of a profuse discharge from an ulcerated

mucous membrane, a solution of zinc sulphate, one dram to the ounce of water, may be used. When there is a great deal of fetor a solution of potassium permanganate, ten grains to the ounce of water, will be found useful. Carbolized solutions may be employed, the avowed aim being to produce a temporary aggravation of the inflammatory symptoms, or to change the chronic condition to one that is more acute.

If the degenerative process shall have proceeded so far as to involve the bony walls, an operation for the removal of the dead tissue will be necessary. These necrosed conditions may be detected not only by the amount and character of the pus, but the condition can be verified by careful explorations with the probe. Whenever the symptoms lead to the conclusion that depraved secretions from the frontal sinus are discharged into the antrum, the opening should be kept patulous and the attention directed toward the other cavity that is the source of the disease.

An opening through the bone of considerable size, that has served for the drainage of pus, will not always entirely close. This will not materially matter, because there will usually be a formation of soft tissue and mucous membrane over it that will be sufficient for the exclusion of foreign matter. Even if this is not accomplished little inconvenience is experienced, provided nothing is kept in it that can retain food until it ferments within the sinus. It will not be in a worse condition than are the nasal passages in cases of cleft palate. It may be necessary periodically to wash out the antrum, but this can readily and easily be accomplished.

CHAPTER XXXVII.

DISEASES OF THE FRONTAL SINUS.

As this cavity is much smaller than that of the antrum, and as sometimes it is practically absent, its pathological complications are less in number and of smaller import. It is another of the openings connected with the air passages, and the reasons for its existence are identical, though of less importance, than in the case of the maxillary sinus. As in the case of all other open cavities it is lined with mucous membrane, and its diseases will be the same as those

of the antrum, except as they are modified by the different environments. It is probable that they seldom originate in the sinus itself.

Inflammations and degenerations of the lining membrane will comprise the most of these, and, while the presence of foreign substances may be eliminated from the list of causes inducing them, the pathological changes will be so nearly analogous that a recapitulation of them is unnecessary. In edemas and empyemas the discharge is through the infundibulum that penetrates the ethmoid, and into the middle meatus of the nose. (See Fig. 45.)

Fig. 45.

Vertical Section of the Skull.

a, The inferior and middle turbinated processes. *b*, Posterior part of the antral or maxillary sinus. *c*, The infundibulum of the ethmoid.

The diagnosis of these conditions must be through the tracing of this vitiated matter to its source, and from the sense of fullness and pressure that will inevitably be felt in the supra-orbital region.

Local treatment will be impossible unless an opening is made, which will be from the lower border of the bone, through the supra-orbital prominence or ridge into the cavity, where it may be treated as in the case of the antrum. But this is a very unusual operation, and seldom called for except in cases of atresia of the

discharging duct or canal, or when the discharge has induced a degenerated condition of the infundibulum, or is flowing into the maxillary sinus.

That these latter conditions may exist and may induce serious complications, the following case in the practice of Prof. Truman W. Brophy amply demonstrates. Miss A. had for some years suffered from what was pronounced antral disease. Five operations for its relief had been made by different surgeons, most of them consisting of the usual opening and flushing of the sinus with antiseptic and stimulating solutions. It was now determined to explore the cavity more completely than had yet been done, and to this end the maxillary walls above the roots of the teeth were removed until the finger could be introduced. No foreign substance or growth was found, and the cavity was temporarily packed with antiseptic gauze. At a subsequent visit this was removed and the antrum critically examined. Near the apex purulent matter from some superior source was observed to percolate into the sinus. The connection of the frontal sinus with the diseased condition had not previously been suspected, but in the light of the then newly published observations of Dr. Cryer it was at once apparent. The infundibulum was discharging pus into the antrum, and the seat of the disease was either in the frontal sinus or in the ethmoid, and a further operation was at once determined upon. At the proper time the supra-orbital tissues were divided, the filaments of the supra-orbital nerve dissected out and an opening made into the frontal sinus, from which pus at once welled up. The opening was now extended the whole length of the sinus, until a probe could be thrust down through the infundibulum for a considerable distance, when its point was found in the maxillary sinus. Careful probing now demonstrated that the cells of the ethmoid were in a degenerated condition, and that the connecting passage was for a part of its length devoid of its membranous lining. With properly shaped burs in the surgical engine the incision was carried along the course of the infundibulum until the center of the nasal bone was reached. A considerable opening was made in this bone, the degenerated portions of the ethmoid were removed, the surfaces of the discharging canal freshened and its mouth made to open into the nasal meatus instead of into the antrum. A drainage tube was now inserted into the frontal sinus, through which the whole terri-

tory could be flushed, and the wound was closed about it. The discharge was for some time very profuse, but continued antiseptic treatment finally resulted in a complete cure. When the infundibulum was made to discharge into the nasal cavity the trouble in the antrum was at once relieved, and never returned, thus conclusively proving that the source of disease was not in this sinus, which was only secondarily affected from the frontal sinus.

CHAPTER XXXVIII.

CYSTS AND THEIR TREATMENT.

A Cyst is a tumor containing a cavity or cavities filled with fluid or semi-fluid contents. In one sense, it is nature's method of isolating from the tissues any foreign or irritating matter. It is the only way in which extraneous substances can be permitted permanently to remain in the animal economy.

When cysts consist of a single chamber they are simple, and when divided by membranous septa multilocular. Should they contain teeth they are called dentigerous cysts. (See Fig. 46.)

A cyst may also be the result of the stoppage of some duct, and the consequent retention of the secretion of the gland of which it was the discharging canal; or it may be the mere collecting of a watery fluid in a previously existing serous cavity, the outcome of functional disturbance.

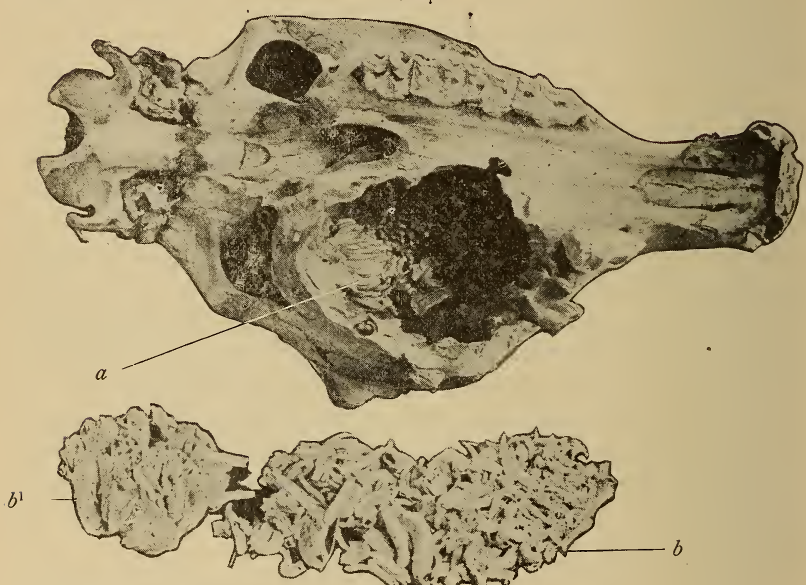
The most common and at the same time the most benign and innocent of these tumors is the sebaceous cyst, which, as its name indicates, is filled with fatty matter. They vary in size from that of a millet seed to that of an orange, and are most frequently connected with the sebaceous glands of the skin.

A cyst consists of a membranous pouch, without an opening, that envelopes the alien substance when such exists, and separates it from the tissues. In like manner a colony of bees, when some animal or offensive substance which they are unable to expel gains entrance to the hive, seal it up and segregate it by covering it with an impenetrable coating of wax, within which it loses its repulsiveness. A cyst is filled with a fluid in which the offending matter

floats or is contained, thus preventing its immediate contact even with the cyst walls.

Cysts are developed in natural cavities of the body, or within the substance of an organ. They cause a distention that with the continual gathering of the cystic fluid and the constant growth of the cyst sometimes becomes of enormous proportions. It is only through their expansion that they assume any dangerous character, for they do not otherwise cause functional disturbances. They

Fig. 46.



Dentigerous Cyst in a Young Horse, containing Nearly a Quart of Denticles. *a*, Mass attached to the bone. *b* and *b*[1], Loose pieces. (From a specimen in Buffalo College Museum.)

may readily be distinguished, in most instances, through this peculiarity, and through their slow formation and the entire lack of pain that accompanies their growth.

The methods of distinguishing them from tumors are various. If they are accessible, the fluctuation of the fluid contents may readily be perceived. Sometimes, when they have existed for a long period without materially growing, a parchment-like crackling will be felt upon pressure, and it may even be heard with the ear.

It sounds very much like the crepitating sound produced by the flexing or bending of bar tin. This is because of the inspissation, or thickening into a grumous, clotted mass of the fluid contents, through their desiccation, or drying. In deeper cysts it is usually advisable positively to determine their character by aspiration, or the drawing off of some of the fluid contents, by means of an aspirating or hypodermic syringe, and its careful examination. This gives a positive method of diagnosis. An exploring needle should also be used, to determine the presence of any foreign or irritating substance.

FIG. 47.

UPPER JAW SHOWING ALVEOLAR CYST AND OTHER DISEASED CONDITIONS THE RESULT OF NEGLECT.

There is recession of the gums and absorption of the alveolar edges due to pyorrhea. The central incisor is thrown out of alignment through the formation of an alveolar pocket on the disto-lingual aspect. A cyst has formed about the diseased apex of a tooth at *a*; there is chronic suppuration with alveolar necrosis at *b*. (From C. Röse.)

Park, whose "Surgery by American Authors" may be accepted as the most modern expression of surgical pathological knowledge, divides these ordinarily benign tumors into four classes:

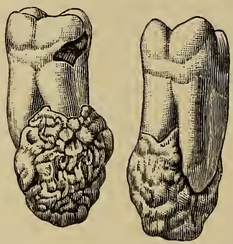
1. *Retention Cysts. These imply a previously existing cavity, whose outlet is stopped up, and whose contents consequently accumulate and perhaps degenerate.* This class will of course include those oral cysts which arise from an obstruction of the ducts of the salivary gland.

2. *Tubulo-Cysts. These are dilatations of certain functionless ducts in other parts of the body.* They are largely developmental in their origin.

3. *Hydrocele. This, as its name indicates, is a collection of watery fluid in some serous cavity, one which has no discharging duct and no opening of any kind.* Hydroceles are apt to be of congenital origin, and are most frequently found in the region of the neck.

4. *Glandular Cysts. These growths are formed by the dilatation of certain glands.* They may usually be classed as retention cysts, for the enlargement is most commonly induced by a stoppage of the ducts. They may, however, occur in connection with the ductless glands, and because of this there is a degree of propriety in distinguishing them from those which arise from the mere closing of a duct.

FIG. 48.



CALCIFIC, STRUCTURELESS MASS INVOLVING THE ROOTS OF A MOLAR.

It had invaded and destroyed cementum and dentine. It was as hard and as dense as bone, but had none of its structure. (Practice of Dr. A. M. Holmes.)

Those which are of interest to the oral surgeon or physician are the first and last classes, tubulo-cysts and hydroceles not being likely to fall under his observation.

Cysts in and about the oral cavity are quite frequent, a considerable proportion of them being caused by calcareous deposits within the salivary glands or in their discharging ducts, and the subsequent formation of a retention cyst.

Ranula is a retention cyst, caused by the stoppage of Wharton's duct, or one of the mucous glands beneath the tongue. A small calculus may be formed within the gland, and it will eventually become lodged somewhere in the duct, completely stopping it. The saliva or mucus is obstructed and forms a cystic pouch or pocket, into which more is continually flowing. The watery portion will

be lost, and there will remain a thick, jelly-like mass beneath the tongue upon one side, which in some instances thrusts that organ quite out of the mouth. It assumes a peculiar mottled appearance, closely approaching that of a frog's belly, and hence it has received the name of ranula, from the Latin *rana,* a frog.

Odontocele or Odontoma is another comparatively common form of oral encystment. These are caused by the presence of undeveloped or misplaced tooth germs. The former term more strictly applies to a cystic, and the latter to a degenerate formation, although both are due to the same cause and are of the same general character. They may appear at any point of the jaws, wherever the undeveloped germ may exist. They are easily diagnosed in most in-

FIG. 49.

AN ODONTOME ATTACHED TO A MOLAR TOOTH THE CROWN OF WHICH IS AT THE APEX OF THE CALCIFIC TUMOR.

stances, not only by the means already laid down, but by the additional fact of there being a missing tooth, and by their location where that might naturally be expected to exist. (See Fig. 49.)

Park, in his "Surgery by American Authors," says that the odontomata are tumors composed of one or more of the dental tissues, arising either from tooth changes or teeth in process of development. He deprecates the lack of attention which has been given to them in surgical literature, and says that no tumor of the jaw, especially in young people, should lead to excision of the jaw until it has been fairly demonstrated that it is not one of this form.

They are divided into—

1. EPITHELIAL ODONTOMATA, *which are provided with a capsule and present usually a series of cysts separated by their septa, containing a mucoid fluid.*

2. Follicular Odontomata, *more frequently spoken of as "Dentigerous Cysts," which arise in connection with permanent teeth, especially the molars, and sometimes reach a great size. The tumor consists of a wall representing the expanded tooth follicle and a cavity containing viscid fluid, with parts of imperfectly developed teeth, sometimes loose and in other instances attached. They occur not infrequently in the lower animals.*

3. Fibrous Odontomata, *which consist of condensed connective tissue in a developing follicle and present a tumor which blends with the dental papilla at the root and is indistinguishable from it. These tumors are common in the ruminants.*

4. Cementoma. *This is a tumor fibrous in character whose capsule has ossified or calcified, the developing tooth thus becoming imbedded in a mass of cementum. These occur frequently in horses.*

5. Compound Follicular Odontomata. *These contain numbers of masses of cementum resembling small teeth, or perhaps composed of the three dental elements.* (See Fig. 46.)

6. Radicular Odontomata. *These are tumors of the roots which form after the completion of the crown. They consist exclusively of dentine and cementum, and are rare in man.*

7. Composite Odontomata. *These are hard tumors, bearing little or no resemblance in shape to normal teeth. They consist of a conglomeration of enamel, dentine, and cementum, thus presenting an abnormal growth of all the elements of the tooth germ. They have been found only in man.*

There are other forms of cysts arising from some functional disturbance in the smaller glands of the mouth and tongue. They belong to the strictly glandular class, and consist of an enlargement or dilatation of a mucous gland. Such an one is frequently found just at the tip of the tongue, where lies the so-called Nuhn's gland. These cysts, however, may be of the simple retention variety, due to a stoppage or closing of the duct of the mucous follicle. Dermoid or congenital cysts are also sometimes found in the mouth.

Sometimes the cystic formation is within the antrum of Highmore, which it fills with cystic fluid. In this locality it is liable to be mistaken for an ordinary edema of that cavity. But after it has existed for some time it usually causes an absorption of the walls of the antrum, when its true nature is revealed. This will most

often occur at the external extremity of the antral cavity, where the alveolar walls are thinnest. At that point, beneath the cheek, fluctuation may readily be observed, and the peculiar feeling of the cystic fluid may easily be detected. If there is yet any doubt, an aspirator needle may be introduced, and a little of the fluid extracted. If this is thick and glairy, with perhaps some flocculent matter floating in it, the diagnosis will be clear.

There is a kind of cyst that is of a distinct interest to the dentist, viz, the ovarian dermoid. These dermoids are teratomatous growths, made up of matter that is developed from the epiblastic layer. Hence we find them containing epithelia, skin, hair, sebaceous glands, and well-developed teeth. If they should contain bone, muscle, or nerve tissue they would not be dermoids, because these are of mesoblastic origin. The author has in his possession a dermoid ovarian cyst that contains nearly forty teeth, some of them deciduous and some permanent, with hair rolled up into a ball and nearly two feet long.

The treatment of cysts is usually quite simple. In most cases it is sufficient first to open the cystic tumor and explore it for the presence of an irritating agent. This, when discovered, should be removed. The contents of the cyst should now be thoroughly evacuated, and the cavity washed out with a weak disinfecting solution, when the whole may be packed with iodized lint. Granulations will usually commence and complete the cure. It may be desirable to wash out the cavity with a stimulating fluid, and wait a little time to see that no undue inflammation succeeds, before the iodized lint is used.

In cysts within the bone, or in the antrum, septa may exist, partially dividing the cavity into two or more portions. These should usually be broken down, that the diagnosis may be complete. This will be found especially true in the maxillary sinus.

In ranula, it is desirable to remove the obstructing calculus and evacuate the cyst without cutting, if it be possible, that the course of the duct may not be changed. A little careful manipulation will not infrequently be effectual in driving the concretion, if it is not too large, out through the course of the duct, when the contents of the cyst may be removed by means of the aspirator. Should the cyst again fill up, it may be necessary to open it, but the natural discharge from the submaxillary gland should be carefully

provided for. There are instances in which it will be found necessary to dissect out as much of the inclosing membrane as is possible. There is little danger from bleeding in any operation upon cysts, if carefully performed, and the only complications are those arising from the ordinary inflammations.

CHAPTER XXXIX.

TUMORS AND NEOPLASMS.

It is not the purpose of this work to enter upon any extended investigation of diseases not commonly encountered by the dentist, or which properly belong to the practice of the general physician or that of any other specialist. But it would not be complete were not a sufficient knowledge of morbid growths imparted to enable the student intelligently to diagnose the condition, even were it essential for him to refer his patient to the general surgeon for any necessary operation. Hence, some general remarks will be attempted concerning the origin and pathology of the more common foreign growths.

The term Tumor implies an abnormal enlargement of a part from any non-inflammatory cause, but usually from a morbid growth, which in its structure conforms to a greater or less extent to the tissue in which it grows, and which has no functional action. A simple inflammation is a tumor in one sense, but not in that which is surgically the accepted one. The term Neoplasm is more applicable to the conditions under consideration, because it implies an abnormal growth, which may be either normally or abnormally located.

All neoplasms, or tumors, consist of tissue that is normal to the body, and that forms an essential part of it when properly developed. But when any tissue of the body grows in a location that is foreign to it, or when it develops in an abnormal manner or in excessive amount, it becomes a tumor or neoplasm. Every hypertrophy is a tumor, because it is an excessive development, though of a normal tissue in a natural locality. If it is developed in an unnatural position, there is a greater departure. If fibrous tissue develops unconnected with other such tissue, or in a place in which

fibrous tissue does not belong, it is a neoplasm. If osseous tissue develops in undue amount in connection with other bone, it may be but an hypertrophy or a hyperplasia. But if it is formed in an abnormal manner, or in an unnatural location, it becomes a morbid tumor. A wart is the undue development or an hypertrophy of one or more of the papillæ of the skin, and it is thus a form of benign tumor. A corn is the impaction of the epithelia in the tissue beneath, but it is not a true foreign growth. When epithelia develop unduly in the midst of other tissues, they form a dangerous kind of tumor.

Neoplasms may be of benign or of malignant growth. In the former case the tissue elements may form a mere harmless hypertrophy, like hypercementosis, sometimes called exostosis of a tooth, while in the latter they are essentially foreign, and therefore irritants, and cause a degeneration and breaking down of tissue. All neoplasms, therefore, are composed of normal cells abnormally developed in number, as in hypertrophies; in position, as in warts, moles, etc.; or in both location and histological arrangement, as in the malignant tumors.

They are named according to the tissue in which they occur, or of which they are composed.

An Epithelioma is composed of unduly developed epithelia.

A Fibroma is composed of unduly developed fibrous tissue.

An Osteoma is composed of unduly developed osseous tissue.

An Adenoma is composed of unduly developed glandular tissue.

An Enchondroma is composed of unduly developed cartilage tissue.

A Myoma is composed of unduly developed muscular tissue.

A Glioma is composed of unduly developed nerve structure tissue.

An Angeioma is composed of unduly developed blood tissues.

A Myxoma, of unduly developed mucous and gelatinous tissue.

Tumors are also named from other peculiarities, appearances and structural character, as—

Sarcoma; having the appearance of flesh.

Encephaloid; having the appearance of a head.

Myeloid; having the appearance of marrow.

Melanotic; having a pigmented or colored appearance.

Scirrhus; having a hard appearance or consistence.

Medullary; having a soft appearance or structure.

Tumors are also Homologous or Heterologous, the former con-

sisting of tissue like, and the latter unlike, that in which it is imbedded. Homologous tumors naturally are apt to be benignant, and heterologous tumors to be malignant in their nature.

Malignant tumors are usually connected with some peculiar diathesis, and there is an hereditary tendency toward their formation. They are embryonic in structure; that is, made up of not fully developed tissue, and hence quite unlike ordinary hypertrophies. They are apt to consist of a network of connecting tissues, whose meshes are filled with abnormally developed cells.

They may be diagnosed from their position, their history, growth, pain, general appearance, etc. As a rule, the faster the growth the more threatening the tumor. This is especially the case if there is pain attending it. Those which appear in middle age are more apt to be malignant than those whose growth is earlier. The most destructive ones are, after a certain stage, accompanied with an extensive ulceration and sloughing of the tissues.

A tumor will usually first appear as a hard nodosity within the tissues. It may increase in size very fast, or its growth may be slow. It may be accompanied with considerable pain, or it may be without functional disturbance. There are a great many benign tumors to each one of a malignant character. As a rule, if the growth is slow and without pain, if there is no special reason for its appearance, if it can be attributed to no particular pathological condition and no functional disturbance is connected with it, little attention need be paid to it. It is probably one of the frequent hyperplasias of an innocent character that may be found in almost every person. It is usually safe under all circumstances to allay the fears which such an appearance almost invariably excites, by the assurance that it is one of the numerous growths that can do no harm, and to endeavor to divert the mind from all thoughts of it. Nothing should ever be said that can excite apprehension. Even if the practitioner is in doubt concerning its true nature, he should not let the patient become aware of it. He should keep it under observation until it has sufficiently developed to enable him to judge intelligently, but always without communicating alarm.

The treatment of the homologous tumors is wholly local. They have no constitutional origin, and do not menace life. The chief reason for interfering at all in many such cases will be found in the fact of their causing inconvenience or disfigurement.

The heterologous tumors represent a constitutional vice. They tend to infiltrate into and invade other tissues. Especially are they likely to affect the glandular system. Local treatment is entirely useless, and even if they are removed they are quite likely to reappear. They never, like the homologous tumors, reach a definite limit of growth, but continue to increase and spread. Their treatment, aside from surgical interference, which is usually advisable except in the later stages, must be specific and sustaining.

CHAPTER XL.

TUMORS AND NEOPLASMS (CONTINUED).

THE term Cancer is one that is not usually employed by professional men. It is derived from the Latin *cancer*, a crab, and the name is given from the supposed crab-like appearance of the veins in this affection. The laity usually understand by it any of the malignant growths which are technically called Sarcoma or Carcinoma or Epithelioma. Of these the sarcomata are composed of embryonic tissue from the mesoblastic layer, while the carcinomata are of epiblastic origin. Each is variously subdivided according to its character or development, and each presents separate physical and pathological characteristics.

Sarcomas have a distinct kind of fleshy appearance, and seem to be specially vascular. They grow along the lines of least resistance, and are likely to penetrate into cavities and fissures of the tissues. They appear at any age, and are comparatively rapid in their growth, sometimes causing considerable pain. When they appear upon the surface they bleed very easily, and have in such cases sometimes been known as Fungous Hematodes. They are comparatively frequent in the salivary glands, in the jaws and other tissues of the mouth, sometimes penetrating to the antrum. They are quite common in some of the lower animals, especially the horse.

An Osteo-sarcoma is one in which the bone tissue is involved. It may be Central, arising in the interior and distending the bony walls; Infiltrating, when the whole bony mass is perme-

ated and softened, or Periosteal, when it has its origin in the periosteum. (See Fig. 50.)

Carcinoma is of epiblastic origin, and is connected with some form of gland tissue. It is rare in young persons, and it commonly involves the lymphatics at an early period of its development. It is usually rapid in its growth, and it may cause a very great degree of pain. It is very apt to attack the breast in women, but its seat may be in the sebaceous glands, the salivary glands, the prostate,

FIG. 50.

OSTEO-SARCOMA OF THE LOWER JAW. (From a specimen in the Buffalo College Museum.)

liver, kidney, testicles, stomach, intestines, especially the rectum, or wherever glandular tissue exists. Hence its location will be an important guide in its diagnosis.

Epithelioma, as its name indicates, is a degeneration of an epithelial surface, usually of the skin, and consists of masses of epithelial cells surrounded and separated by bands of connective tissue. It belongs to the malignant growths, though it does not necessarily assume their form. It is most apt to attack those beyond middle life, and is much more common in men than in women. It sometimes

arises upon the lip, from the long-continued irritation of a pipe. It is also not infrequently caused upon the tongue, or in the oral tissues, by the pressure of rough, sharp edges in carious teeth, which act as a continuous provocation. Its diagnosis is not usually difficult. Its late and superficial appearance and the chronic ulcer with indurated edges forbid its being readily confounded with anything else, unless it might be some forms of syphilis.

Lupus is one of the many forms which tuberculosis assumes. It is strictly a communicable disease, and is due to an infection by the tubercle bacillus. It usually commences early in life upon the face, in the form of small red or dark spots, which are much softer than the inclosing tissue. They ulcerate in time, and, spreading with the deposition of more tuberculous matter, there is a steady erosion into the surrounding territory. The infection of the system with the tubercle bacillus is always a grave matter, and is liable to cause many complications. It is a question to be taken into careful consideration when any surgical measures are contemplated, because the appearance of miliary tubercle would interfere with the healing process. It is impossible within the limits of a work like this thoroughly to consider the many phases which tuberculosis may assume, and the student who desires further information is referred to works upon general surgery.

Of the non-malignant tumors, those most commonly found in the mouth are the different forms of fibroma. These, as their name indicates, are composed of fibrous tissue. They are ordinarily dense in structure, and composed of bundles closely packed together, which are permeated by bloodvessels. The Epulids belong to this class, as they are of fibrous origin.

Lipomas, or fatty tumors, are the most frequent of any of the neoplasms. They are of the adipose tissue type, and it is needless to say are harmless in their character. They are usually inclosed in a capsule, from which, if no vital organ is involved in these folds, they may readily be enucleated. They are easy of recognition, except when deeply located, and when once extirpated are not apt to return.

The Osteomas are bony tumors, and are by some believed to be chondromas, or cartilaginous tumors, which have ossified. They may be either compact or cancellous in structure. They are most common about the cranium, and may be found in the frontal sinus,

the external auditory meatus, and about the mastoid process. The compact forms are sometimes very dense and hard, appearing like ivory, and they may defy the finest steel instruments. Some forms of odontoma are classed with osteomas.

The student will be especially interested in the methods by which tumors of malignant growth may be distinguished from those which are benign. This may usually be done by the clinical symptoms, although there are instances in which the most careful observation will be at fault. Some of the foreign growths will present misleading characteristics, but the following points of difference may usually be relied upon:

Benign tumors are common to all ages, while those which are malignant do not appear in early life.

Benign tumors are slow in formation, while the malignant are usually of rapid growth.

Benign tumors do not spread and infiltrate into the surrounding tissues, while those which are malignant infiltrate in all cases.

Benign tumors are often inclosed in a capsule and are circumscribed, while malignant tumors are never thus limited.

Benign tumors are rarely adherent, while malignant ones always are.

Benign tumors rarely ulcerate, while the malignant ones always do when they come to the surface.

In benign tumors the overlying tissue is not disturbed, while in the malignant it is more or less retracted.

There is no lymphatic involvement in the benign tumors unless they are inflamed, while malignant tumors almost always involve the lymphatics.

The treatment of the tumors is almost exclusively surgical. Those which are benign seldom return when they have been extirpated, while the malignant ones usually do. If the latter have made considerable progress, and especially if the lymphatic glands have become enlarged and indurated, they are almost certain to reappear. Yet excision, even of the most destructive forms, will usually prolong life, if it does not permanently save it. There is but one safe method of removing them, and that is by the knife. The eroding plasters of the so-called "cancer doctors" are not only the most painful means of effecting removal, but are eminently dangerous, being very apt to hasten infiltration, and in some in-

stances they may convert a tumor of a benign aspect into a malignant type.

The dentist will be mainly interested in the epulitic growths that are common in the mouth. The usual form of epulis is a vascular tumor that appears upon the gums. Its origin may be from the superficial fibers, from the pericementum of a tooth, or it may penetrate into and appear to have its root in the alveolus. The term "Epulis" means "upon the gums." Hence it is applicable to any abnormal gingival growth, and the hypertrophies that, proceeding from the gums, sometimes fill the cavities in decayed teeth are true epulids, though of a simple character. Epulids may appear as erectile or as non-erectile tissue, and may have fibrous, myeloid, myxomatous or sarcomatous complications.

The erectile epulids are vascular growths, whose size depends upon the vascular condition, and they vary with this. When distended they appear tinged and dark. When not distended they are flaccid, pale, and contracted.

The epulitic tumors that spring from the periosteum perhaps invade the substance of the bone. They may be diagnosed by careful movements and by the exploring needle, which may possibly detect an opening into the bone.

If the origin is from the pericementum of a tooth, a peduncular connection may usually be traced, either through the alveolar walls or by the side of the tooth, in the direction of the pericemental membrane.

For the removal of the superficial and erectile tumors, little more is needed than a ligature that shall cut off all circulation, with final cauterization of the place. An epulis that has its origin in the pericementum of a tooth will be cured by extraction. But for those which penetrate the bone, it will be necessary to remove as much of the alveolus, or even the body of the maxilla, as is affected, remembering that the extremity of the invasion must be reached. The wound should be dressed with iodized lint. If there is much inflammation the following may be applied:

℞—Plumbi acetatis,	ʒij;
Tinct. opii,	℥ij;
Aquæ,	℥xvj.

Sig.—Pack the wound with lint wet with the solution.

CHAPTER XLI.

OSTEITIS.

Before entering upon the consideration of diseases of the bone it is necessary thoroughly to comprehend the pathological changes involved in the initial steps of the degeneration. Bone, which forms the framework of the body, is made up of an inorganic, or mineral portion, and an organic, or living part. The latter is contained within the meshes of the former, and communicates through the whole structure of the bone. This is accomplished by means of the peculiar formation of the inorganic part. It is through the organic or living portion that nutriment of the whole osseous tissue is carried on. The changes that occur in the inorganic portion, the waste and repair, are not, of course, as great as those of vascular tissue, yet they must be provided for in the economy of nature.

The nourishment of the bone, like that of all other tissues, must primarily be derived from the blood, and it is carried on through the periosteum or investing membrane, the medullary marrow or central cavity in long bones, and the Haversian or penetrating canals which carry the blood to all portions of the thick bones. Around the Haversian canals, and along all the sources of nutriment, are arranged a concentric series of cells containing the essential living matter of the bone. (See Fig. 51.) These cells are the lacunæ, and each of the zones of these so concentrically arranged cells is called a lamella. Connecting the several lacunæ, and communicating with the nutrient source—the periosteum, the medulla, or the Haversian canals—are the canaliculi, the minute canals which carry the pabulum extracted from the blood to the lacunæ, the immediate source of nutriment.

The living contents of the lacunæ and the communicating canaliculi are of a protoplasmic or embryonal character, and contain the elements of the osseous tissue. If the nutrition of its structure is cut off, the bone dies as inevitably as does any other tissue under like circumstances. If a ligature is placed about the finger that is sufficient to prevent all circulation, and thus to stop all nutriment, the soft tissue will die and become gangrenous. If the ligation is

so complete as to deprive the bone of its nutrient currents, that will also die from the same reason, and become necrosed.

If the stoppage of nutrition in the finger is through a progression of the inflammatory process, by hyperemia, congestion, and final stasis of the blood current in the part, the result is precisely the same as if it were through a ligature, or separation of all arterial sources of supply. It matters not by what the nutrition is completely interrupted, whether by starvation—stoppage of food supply either to a part or the whole of the body by cutting off that supply

Fig. 51.

Lamellæ of Bone, showing also the Lacunæ and Canaliculi. (From Gray.)

through interruption of the channel of conveyance—or by such pathological changes as completely to prohibit assimilation of food products, death of a part or the whole of whatever is thus deprived of its food supply must be the inevitable result. In the soft tissues this may be called suppuration, ulceration, sloughing, or gangrene, and in the hard portions caries, exfoliation, or necrosis, but it is essentially all the same process. Each is but a different manifestation of the universal law of death and decay whenever nutrition and progress cease. The instant that progression stops, retrogression commences.

The contents of the lacunæ and canaliculi of bone, the protoplasmic embryonic elements, although they are not directly vas-

cular, may be the subjects of inflammatory action. This process, differing from ordinary inflammation in some particulars because of the varying physical character of the affected substance itself, as well as of its environments, will arise from the same causes as do inflammations of other tissues, and may be studied from the same standpoint.

The initial point will undoubtedly be in the tissue or organ that is the immediate source of food supply,—the periosteum, the investing or lining membrane of the bone. Disorders of this tissue must affect the living portion of the bone. Inflammation of the periosteum, if the degenerative process continues, ends in stasis of the blood currents, thus cutting off nutrition, with the consequent deterioration of the living contents of the lacunæ and canaliculi.

This inflammation, or affection of the living portion of the bone, is that which we call osteitis, and it is usually the initial point of necrosed conditions. If the osteitis is relieved through the removal of the source of irritation and the re-establishment of nutrient currents, that is essentially the resolution spoken of in dealing with Inflammations. If it proceeds to the breaking down of tissue it will be caries or necrosis, the analogues respectively of suppuration and gangrene.

Like all other inflammatory conditions, osteitis is the result of some irritant. This may be a traumatic lesion, the presence of pus or of a foreign body, or the interference with nutrition caused by some external impression manifested through the nervous system. Anything that would induce the inflammatory process in the soft tissues may in a less degree be provocative of osteitis in the hard. Probably there was never an acute pericementitis that did not induce a corresponding osteitis in the bony tissues in the immediate proximity. We know that an alveolar abscess causes a breaking down of the bone about the infected spot, and the formation of a cavity of greater or less extent. We are also but too well aware that pus from an abscess sometimes infiltrates the bone, and will burrow to a considerable distance, forming secondary pockets and foci of infection, which sometimes make thorough sterilization very difficult. We know, too, that it takes considerable time to effect the complete healing of the pockets and cavities in the bone thus formed, and that until the embryonic or temporary tissue that is the result of the first reparative process shall have time to con-

solidate and become permanent through further progressive changes, there is always danger that the metamorphosis will take upon itself a retrogressive state and the whole again break down.

All these conditions go to demonstrate the fact that osteitis, to a greater or less degree, is always present in pericemental complications, and that in the treatment of such conditions its existence should be taken into account and care taken that it be kept in check.

Symptomatology and Treatment.

The diagnosis of osteitis as a separate infection is not readily made, and principally depends upon other known degenerative processes. The existence of an abscess in the immediate neighborhood of any osseous tissue must inevitably induce it. The mere presence of pus and of the micro-organisms of suppuration are sufficiently irritating to provoke an inflammation of periosteum, and that necessarily implies more or less of osteitis. But aside from such recognizable complications the condition does not present sufficient of pathognomonic symptoms to enable the observer always to detect it in its earlier stages. It may often be inferred, and in some instances perhaps determined, by exclusion of all other functional disturbances, but the pathologist must mainly depend upon associated disorders for his complete diagnosis.

The periosteal inflammation that is the cause of, or that accompanies it, will manifest itself by a red line, or red blotches upon the superincumbent tissues, provided they are not too thick, and this will be intensified if there is very much of osteitis present. But this cannot be depended upon as a certain diagnostic symptom, though it may be useful as an adjunct.

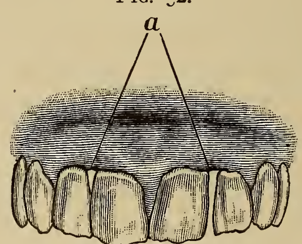
The treatment of osteitis in its early stages should be abortive, and it will not materially differ from that laid down for the relief of inflammation in other tissues in the chapter (X.) devoted to that subject. Its presence once determined, every effort should be made to discover the source of irritation and to remove it. About the jaws this will most frequently be a diseased tooth, and when that is restored to a healthy state, unless the disorder shall have existed for some time or the lesions be unusually violent, the inflammation in the lacunæ of the bone will subside with the rest. If, however, this is not the case, and the retrogression or degenerative action persists, it will result in either caries or necrosis of the bone, and these will be considered under their appropriate heads.

CHAPTER XLII.

CARIES OF ALVEOLAR BONE.

In dental practice this disease may be compared to suppuration or ulceration in soft tissues. It is the devitalization of bone, cell by cell, and its breaking down by a comparatively slow progression, rather than death in mass. It has its origin in perverted or interrupted nutrition, but the phenomena exhibited vary somewhat from those of necrosis. It most frequently arises from local irritations, but it may be general and constitutional in its origin, as in the case of scrofulous subjects or those affected by the syphilitic virus. A frequent source of maxillary caries will be found in the diseased roots of teeth, which act as sources of irritation. Not infrequently, too, it is the result of excessive violence in dental operations. Long-continued wedging will be likely to induce a local osteitis so severe as to interfere with the nutrition of the thin septa of bone between the teeth, denude them of periosteum, and result in a wasting caries which will destroy that portion of the alveolar process by slow disintegration. (See Fig. 52.)

Fig. 52.



Loss of Septa through Alveolar Caries.

a, Depressions in the bone, with denudation of the cervix of the tooth.

It will be comprehended that this form of caries materially differs from that which is by surgeons usually denominated caries of the bone, both in its etiology and symptomatology. While it may be aggravated, or even induced, by cachectic conditions, it is not characterized by the substituted granulation tissue. It more resembles in its progression dental caries, but is quite distinct from the latter in many of its characteristics. This form of caries of the

bone may be readily diagnosed, through careful examinations, by any one who is skilled in such matters or who has cultivated habits of close observation. Yet the earlier periods in these perversions are recognized by but few dentists, because their perceptions have not been sharpened by continual practice. Either they are not sufficiently instructed to know what to look for, or they do not extend their observations beyond the teeth themselves, and neglect everything save that which obviously demands mere mechanical or operative interference. Any localized congestion or inflammatory turgescence and swelling demands the attention of the practitioner. It may be indicative of a slight disturbance, or it may be the initial point of a serious lesion. The oral physician should be competent to determine which it is, and faithful enough to keep it under observation until it shall develop its true character; and the condition should be recognized early enough to enable the practitioner to obviate the spontaneous formation of sinuses.

True caries of bone will produce a marked change in the overlying soft tissues. There will in the incipiency be great determination of blood to the parts, with congestion and tumidity. This will gradually assume a deeper color, until it approaches a purple hue and sloughing commences.

In simple denudation caries of the maxillary process there will be very little of this, nor will there be any very considerable formation of pus. But there will be limited sloughing of the superimposed tissues, with denudation of the bone, more or less complete, beneath. An opening through the soft tissues will be found, and this may be discharging a small amount of pus, though without acute complications. If now a probe—the best one for such cases is a hatchet-shaped excavator—or an explorer of some kind be carried through this opening, the bone will be found quite denuded and exposed. The point of the excavator will readily enter it, and small spicula from the roughened surface may be readily chipped off. There will be none of the smooth, solid, resisting sensation that a healthy bone presents. To the educated sense of touch it presents characteristics that cannot well be mistaken. If there is caries of the septum of the bone between the teeth, the result of traumatic violence, perhaps in wedging or filling, there will be a peculiarly rough, gritty feeling, showing that portions of it have been thrown off, with destruction of the periosteum. There may be

a distinct putrefactive odor from the diseased territory, showing that food is undergoing decomposition there, even if there is no appreciable formation of pus. These conditions and appearances distinguish alveolar caries from the resorptions of the alveoli which normally occur after the extraction of the teeth and the destruction of the pericementum, upon the integrity of which membrane the tooth sockets are dependent.

The treatment of this form of caries of the bone will be almost entirely local. If the degeneration is extensive, it may possibly indicate a general debility that will demand the use of tonics, but this will be very unusual, to say the least. The dead and carious bone should be burred away with the dental engine, and, if necessary, the diseased surface carefully curetted or scraped. This process must be carried to the extreme limits of the affected bone, which, unless there is a carious sinus, will not be very deep.

This done, and all *débris* carefully washed away, the surface of the diseased bone may be saturated with aromatic sulphuric acid, which may be allowed to act for a few minutes, when the cavity should be thoroughly washed with water. That an acid, especially sulphuric, will exercise a selective action, dissolving only dead tissue, seems to be proved by the experiments of the late Prof. J. E. Garretson, who caused to be submitted to the action of a twenty-five per cent. solution of sulphuric acid, for three days, fragments of dead, of diseased, and of healthy bone, with the result that in dead bone a considerable proportion of the lime salts was dissolved, in the diseased bone a less amount, while in the healthy bone no such action took place. Great care must subsequently be exercised to keep the territory clean and aseptic, disinfectants or antiseptics being used if necessary.

If the tissues seem indolent, they may be stimulated to action by the use of a weak solution of the chloride or iodide of zinc. Opportunity must be given for the formation of a new periosteum, and when the reparative process is once under way the forming tissue must be left undisturbed, except for occasional gentle irrigations with an antiseptic or stimulative solution when that is absolutely necessary. Many practitioners defeat their own efforts by uncalled for and meddlesome interference—by over-treatment when all is progressing satisfactorily.

The preceding remarks apply more directly to caries of the

alveolar process of the jaws. In caries of other bones there is almost always some cachectic condition, such as tuberculosis or syphilis, which induces the carious degenerations. (See Fig. 53.) If there is infection by septic organisms suppuration of course ensues, and the disease may assume a more destructively active necrotic type. In dry caries of the alveolar process, which is the form most frequently met with by the oral practitioner, there is nothing of this kind, nor is there necessarily a constitutional dyscrasia, the local irritation being sufficient to induce the gradual wasting of the cancellous bony tissue, through the gradually progressive cutting off of nutrition.

FIG. 53.

CARIES OF ULNA AND RADIUS.
There are no such cavities found in the bone as in Fig. 54.

In oral practice, then, a distinction may readily be made between the carious disintegrations of the alveolar process of the jaws that may not be accompanied by any specially inflamed conditions and in which there are few if any traces of ulceration, and the porous, abscessed state of true caries, which is surrounded by foreign, unhealthy granulations of the soft tissues. The one is merely a gradual disintegration of the alveoli, brought about by the deprivation of the nutrient supply, with denudation of the process by sloughing of the periosteum. The other is the breaking down of osseous tissue with the formation of fetid pus, which tends to burrow into the tissue. The first is due to simple lack of nutrition, usually the result of some injury, while the other is a cachectic state arising from some constitutional disturbance, the tuberculous deposit being its most frequent accompaniment.

The only treatment demanded by the progressive crumbling of the alveolar process will be to remove any irritating cause, bur out the bone that is denuded of its periosteal covering and that is

disintegrating, retain the gum tissue in place over it—by stitches if necessary—and then, by the use of stimulating astringents, to induce a new membranous growth.

If there is an ulcerative condition, due to a dyscrasia, constitutional treatment will be demanded, and this will consist in the prescribing of nutritious diet, cod-liver oil, hypophosphites, syrup of iodide of iron, etc., with the local treatment previously recommended, and specific remedies when indicated.

CHAPTER XLIII.

NECROSIS.

Necrosis of the hard tissue is the analogue of gangrene in the soft. Its progress is not so rapid, because of the difference in the physical characteristics of the tissues themselves. But its origin is in an identical disturbance of nutrition, its course presents the same pathological changes, the termination is usually similar, and the treatment involves the consideration of cognate principles. Inflammation forms the initial point in its morbidity, and it is from that standpoint that the degenerate modifications should be studied.

Necrosis differs from caries of the bone rather in degree than in essence. As gangrene is the death of soft tissues in mass, so necrosis is the devitalization of a territory having an osteogenetic origin. Like caries of bone, its cause may be either traumatic or specific, local or constitutional. It may attack any of the bones, but the maxillæ are especially subject to it; necrosis of the lower jaw is four times as common as in the upper. In simple caries of the alveoli this proportion is nearly reversed. When not the result of an injury, its origin is in an inflammation of the investing or lining membrane, which spreads to the lacunæ of the bone, thus producing osteitis, which eventually reaches the point of entire inhibition of nutrient currents, with subsequent death of a territory more or less extensive.

Necrosis is usually an indication of a weak, anemic, or debilitated condition. When all the functions of life are active and general nutrition is good, vitality in a part will be maintained

despite unfavoring conditions. But when there are defects in the assimilative process retrogression is easy, and there is a predisposition to wasting diseases. The most fruitful source of necrosis of the maxillæ will be found in the presence of decayed, diseased, irritating roots of teeth. These initiate inflammations, and exacerbate them when once started, prevent nutrition, and hence provoke devitalization. When the suppuration of alveolar abscess takes place the pus may burrow beneath the periosteum of the bone, and, separating it, cut off nutrient currents from the territory beneath. This will be especially probable in the lower jaw, for drainage of its pus pockets is usually imperfect, while gravity constantly tends to bring about infiltration; and this will in part account for the greater proportion of cases of necrosis in that bone.

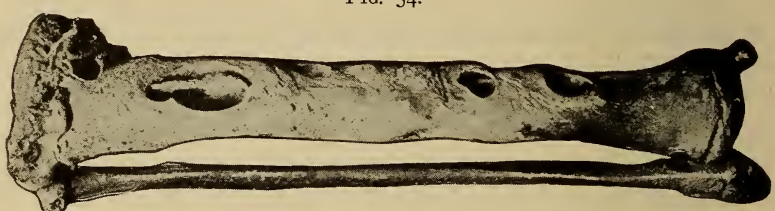
A fruitful cause for necrosis of the jaws will be found in impacted teeth, arising from the lack of room for their proper development. This is especially true of the third molars, the body of the jaw between the symphysis and the ascending ramus often being too short to afford room for all the teeth. When the time comes for the development and eruption of the wisdom tooth all the space is occupied; it is imbedded in the tissues without power to advance, and becomes a source of violent irritation. An inflammation is excited which assumes a peculiarly vicious character, and, the irritant still remaining, there is breaking down of tissue, infection, and suppuration. In the general degenerative state this spreads to the bone, with consequent acute osteitis and necrosis. This condition, to which the upper jaw is not as liable, yet further accounts for the disparity in the relative number of cases in the two jaws.

Necrosis may also be the result of injuries done by the dentist. Fractures of the alveolus in extraction are very common, but such is the recuperative power of these very vascular bones that nature usually buries the faults of the incompetent or reckless operator beneath new formations. If, however, the patient is suffering from any form of atony, the reparative process may not be sufficiently active to restore the normal condition, and retrogression may take the place of progression. In such patients the mere careless puncture of the alveolus to some depth by a sharp-pointed excavator, or plugger, or engine bur that has been infected by some septic product, may produce inoculation that will result in serious necrotic

complications. Arsenous acid, when used in too great quantity for the devitalization of a tooth pulp, or if not securely sealed in the cavity of decay, may penetrate to the alveolus and produce a necrotic condition that will spread to other tissues.

The pericemental inflammations consequent upon the death and infection of the dental pulp are a fruitful source of necrosis of the alveoli and maxillæ. As has been elsewhere asserted, these always induce an osteitis more or less severe, and when the irritation is continuous, as in the case of atonic patients, it may very readily result in death of the adjacent bony tissue. The premature filling of the roots of septic teeth by the dentist has been responsible for many cases of necrosis. The introduction of the filling before the

FIG. 54.



NECROSIS OF TIBIA, SHOWING CAVITIES IN THE BONE.

septic state shall have been completely made aseptic, and before the healing process has been fairly initiated, tends to keep up an irritation which is fatal to healthy functional activity.

Certain zymotic and exanthematous diseases sometimes have necrosed conditions among their sequelæ. This is especially true of scarlet fever. Mercury, when given in large doses, may cause it. Tertiary syphilis is quite likely to attack the palate and nasal bones. People who, having dead teeth, work in match factories, are especially liable to a form of affection called phosphor-necrosis, caused by the fumes of the phosphorus used, which is supposed to penetrate through the root canal, and thus to come in contact with the pericementum which gives nutriment to the alveolar sockets. So universally is this special condition recognized, that in France every factory that uses phosphorus in the manufacture of matches must employ a dentist, whose duty it is periodically to examine all the inmates and forbid the employment of any that have dead teeth with unfilled roots.

The diagnostic signs of necrosis are usually distinct and well marked. With the death of the bone, the overlying tissues with which it is invested become peculiarly turgid and inflamed. They finally assume a characteristic purple tint, and look exceedingly angry. This is increased as the tissue commences to break down beneath the surface and suppuration ensues. There is little of the characteristic "pointing" of alveolar abscess, but the pus finds its way to the surface at a number of places, and the discharge is usually profuse and fetid. If now an explorer is passed into one of the sinuses until it reaches the bottom, the characteristic sensation imparted by dead bone will be plainly felt; or if the disease has been peculiarly active in its character deep cavities may be detected in the bone, with crumbling, disintegrating edges. (See Fig. 54.) Minute chips of the degenerated bone may be easily separated with any appropriate instrument. There will be the usual septic fever, and this may be decidedly pronounced. There will be a general malaise and loss of strength and vitality.

The constant tendency on the part of nature is to get rid of the dead and irritating tissue. The very suppuration that accompanies all necrosed conditions is a part of this process. It is indicative of a disposition to slough away the diseased portion. Sometimes this is successful. There is a clear line of demarkation drawn between the dead and the living tissue, and the granular lymph acts as a kind of wedge to separate them. If this is accomplished, the dead part that is thrown off is called *the Sequestrum.* At the same time there will perhaps be a successful effort on the part of nature to reproduce the bone, and this may be outside of and envelop the sequestrum. Such new enveloping bone is called *the Involucrum,* and it may entirely prevent the exfoliation of the sequestrum. (See Fig. 55.)

When there is extensive alveolar necrosis of a peculiarly active type it is not always judicious to extract teeth, even though they are plainly involved. There is a difference of opinion upon this point among pathologists, but it must be evident to all that if the disease is the result of an acute osteitis, and the attachment of any part of a tooth is in live bone, its extraction will produce a wound that will be certain of infection; the inflammation will spread and a new focus will have been produced, which might have been avoided had the tooth been left to the slower process of exfoliation. On

the other hand, if the tooth is a distinct irritant that is aggravating the situation it should be removed, provided it may safely be done. It will therefore be seen that it sometimes requires the nicest discrimination to determine this point.

If there is a tendency toward the formation of a sequestrum, the dentist should not be precipitate in attempting its removal. He naturally desires to hasten this process, but good judgment must be employed, and it is usually safest to await the exfoliation which will follow in due time. If it is violently torn away before

Fig. 55.

Necrosis of Humerus, showing Sequestrum and Involucrum, the One Found Within the Other.

the separation of the dead from the living tissue is completed by nature an open wound is produced, as in the case of extraction of a tooth, and at this point, minute though it may be, inflammation may begin anew and the diseased state thus be aggravated. But when a fissure of separation can be felt, a pledget of antiseptic cotton or gauze may be crowded in, and thus a little pressure made to assist the process of exfoliation.

CHAPTER XLIV.

TREATMENT OF NECROSIS.

The treatment of necrosed conditions may be divided into three parts,—local, operative, and general. The first will consist of the use of disinfectants and depurators. There will be little occasion for antiseptics, because the flow of pus cannot be prevented as long as there is dead bone. But the whole diseased territory should be kept as carefully drained as possible, and it should be frequently and effectually cleansed with some good disinfectant. For this

purpose electrozone, or meditrina, will be found especially useful, or peroxide of hydrogen, or a three per cent. solution of pyrozone may be injected with a syringe or applied with an atomizer. If the discharge of pus is into the mouth, that cavity should be frequently washed with an antiseptic gargle, and as much care as possible should be exercised to avoid swallowing the septic products. A drainage tube, or strip of iodoform gauze to serve as such, may be introduced into the sinus if its location is such as to demand it, and this may be held in place, if practicable, with strips of adhesive plaster. Of course, neither of these will be appropriate if the discharge is within the oral cavity.

Sulphuric acid may, in some instances, be profitably employed to dissolve out the dead bone. It may be used in such strength as the nature of the case demands, from a dilute aromatic solution to the chemically pure. Of course the latter will only be employed with caution. There is no danger to the soft tissues involved, unless possibly from the chemically pure, and even that involves no serious effect if it is properly used and washed away in time. Local stimulants may be employed to overcome the indolence if necessary.

The operative measures to be employed will consist of those necessary to secure perfect drainage, and operations for the removal of the dead bone. Sometimes in the lower jaw a deep pocket will be formed in the body of that bone, through the enlargement by necrosis of the socket of a tooth which was the original cause of irritation. Drainage of this may be impossible, through the inability of the tissues to expel the pus over the borders.

In one such case the author, against his own better judgment but at the solicitation of both the patient and the dentist who had referred her to him, attempted in vain the acid treatment after thorough burring out of the necrosed cavity. The pocket could not be kept clean, and reinfection from the retained pus was certain, until an anesthetic was given and an opening made from outside the face and beneath the jaw into the cavity. A strip of iodoform gauze was then passed through into the mouth, drawn back and forth repeatedly, and the end finally left projecting from the external wound to assist in drainage. The result was a speedy and complete cure, without the use of any other agents. In some cases of necrosis of the upper jaw, operative measures may be necessary

to open completely and straighten out the sinus of discharge. This may be readily done by a proper bur in the dental engine.

The operation for the complete removal of dead bone in the maxillæ may be of a formidable character, and its consideration properly belongs to the domain of oral surgery. It must be thoroughly done, if done at all. Half-way operative measures are of little account. The patient, having been properly fortified with nourishing food for a time, is anesthetized and placed in such a position as will afford complete command of the situation. The superincumbent tissues are laid back by the proper incisions, the blood checked by ligatures or the use of hemostatic forceps, and the territory carefully sponged and examined. When the extent of the lesion is fully determined, the proper steps are taken for the removal of the dead and diseased bone by the use of the dental engine, bone chisels, scrapers, and saws. When this is completed, all exposed edges of bone must be made smooth, every particle of *débris* removed, and the wound antiseptically washed and properly closed, with sutures if necessary, a drainage tube inserted, the exterior dusted with iodoform powder, and the whole enveloped in the proper bandages and dressings. If the wound is wholly within the oral cavity, of course the iodoform dusting and the bandaging will not be called for. The desirability of working within the mouth when practicable cannot be too strongly urged, especially in the case of young women, that disfigurement may not be the result; but the success of an operation should not be jeopardized in the effort to avoid minor disfigurement. A visible scar is better than death, or even the entire loss of a bone.

General or systemic treatment is called for in almost every case of extensive necrosis. The disease is of such a wasting nature that, at the very least, tonics and a sustaining diet will be called for. The patient should be made to live out of doors as much as possible, and every hygienic precaution be taken. If the lesion is the result of some cachectic condition, like syphilis or mercurialization, the general treatment proper to such condition must be instituted. For the former a strict course of specific treatment will be demanded. The subject is presented in another chapter, and hence it is not necessary to pursue it farther in this connection.

The tonics that are used in wasting diseases are of two kinds,—vegetable and mineral. The former consist mainly of the bitter

barks of certain trees, while the latter are inorganic substances that exercise a peculiarly stimulant or alterant action that tends to prevent waste or assist nutrition. Of the vegetable tonics, Peruvian bark or cinchona, quassia, gentian, and wild cherry, with their alkaloids, are those most commonly employed; while the inorganic or mineral agents most used are preparations of iron, of copper, and of zinc, with such other remedies as subnitrate of bismuth and sulphuric, nitric, hydrochloric, and oxalic acids.

CHAPTER XLV.

HYPERSENSITIVE DENTINE.

Were it possible to rob operative dentistry of the horrors too often its determined attendant in the pain and anguish that excavation of carious teeth causes, public health would be greatly conserved and human life would be correspondingly lengthened, because of the greater care that would be bestowed upon those organs. Would the public generally learn to look upon the dentist in his true light,—that of one whose mission it is to avert pain and suffering,—he would be regarded with much greater favor and would enjoy higher consideration. But the nature of his work is such that, like the general surgeon, in his efforts to forestall future anguish he too often brings present distress, and too many who should be his patients choose to postpone the evil day and hazard all the future rather than risk a moment of the present.

Recognizing all this, dentists from the earliest period in the history of their art have been constantly striving to devise something that will give exemption from pain in dental operations. Most of their efforts have been entirely empirical, and often experiments and labors have been conducted in a haphazard way that betokens anything but professional erudition or scientific knowledge. Those who have claimed to accomplish anything in the way of a solution of the problem, have not usually been those who were best equipped by education and professional attainments for the task. The practitioner who advertises "painless dentistry" has passed into a byword, and the term is a synonym for an impostor and a charlatan. Almost invariably those who have brawlingly

boasted that they have discovered a universal panacea for all dental pain have been illiterate, undisciplined, unknown pretenders, whose sole object was to secure a dirty dollar by unprofessional methods, and to make profit out of that which should be public philanthropy; men who would, if possible, garner the sun's beams and peddle them out for individual gain; who would put holy things to an unholy use, and make of human beneficence a public prostitute. Of this character have been most of the widely advertised preparations for obtunding the dental tissues,—quack remedies, prepared by dental quacks for quackish purposes. The student and practitioner should avoid them if he is an honest man, for he has no moral right to recommend to a patient, who pays him for special knowledge, any drug of whose exact nature and therapeutic value both are alike ignorant.

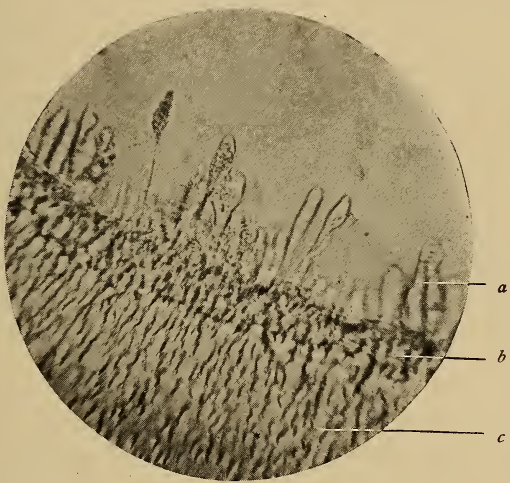
In its normal condition dentine should be without sensation. There are no organized nerves to convey impressions, even were the tooth-bone subject to them. Yet the protoplasmic, albuminoid contents of the dental tubuli may, under special irritation, become the subjects of inflammatory conditions, in which they not only receive, but readily transmit to the dental pulp, external impulses of a painful nature. (See Fig. 56.) It is true that the pulp of the tooth is supplied with nerves; yet they are without some of the characteristics of ordinary nerves, and, protected from all irritating shocks as it is in its normal state, even the pulp is not of itself responsive. Only when some of its protection is withdrawn, or when from some reflex source the pulp is subjected to special irritation, does it become impressible to outward agencies and convey disagreeable sensations.

We know that it is a law that animals, and organs and tissues, adapt themselves to their environments and change their structure with varying conditions. Thus the fishes of rayless caverns lose their sight, and certain inhabitants of the greatest ocean depths are without the usual sensory functions. Both, by gradual transmission to other surroundings, would develop special senses, as have other organisms. Continual subjection to external irritation may either weaken or develop the corresponding sentient perceptiveness, through which alone can defense and security be obtained.

That both dentine and dentinal pulp are without ordinary sensation when in a perfectly healthy and normal condition, is

proved by the fact that when a healthy tooth is fractured and the pulp thereby completely exposed, it is irresponsive to external irritants for a short time. Healthy pulps are painlessly "knocked out" by a certain class of practitioners, provided the teeth are sound and the work is done quickly enough. But if there is the least inflammation in either pulp or dentinal fibrils the operation is anything but painless. There is not a practitioner of extended experience who has not at some time cut into the dental pulp entirely without the knowledge of his patient, provided he was excavating in dentine that was completely or even comparatively irresponsive.

FIG. 56.



FORMATIVE DENTINE, SHOWING THE PROTOPLASMIC FIBRILLÆ.

a, Odontoblast cells of the pulp, with Tomes fibers or dentinal fibrillæ; *b*, Forming dentine. *c*, Formed dentine cut diagonally across the tubules. (Andrews.)

The source of sensitive dentine, or of impressionable pulps, lies in their continued subjection to irritation, by which responsiveness is developed. The freshly exposed pulp, or dentine, of a perfectly healthy tooth, is without sensation. But a few moments of subjection to external influences, the air and other irritants, are sufficient to produce a marked change in the tissues, and they become exquisitely responsive. A kind of inflammatory degeneration takes place, and normal function is so altered that disagreeable currents are conveyed. This is in perfect harmony with the other

known processes of Nature, for in the presence of danger she always develops means of defense by giving warning through the awakened senses.

If, then, in the normal state the tooth tissues are without sensation, it follows that if a pathological condition is succeeded by one of perfect health, the immunity to pain should be re-established. This is undoubtedly the fact, for teeth that have been attacked by caries, and which under its influence have become painfully sensitive, have, when the broken continuity has been restored by a filling, lost that responsiveness and again become insusceptible to external impression. It is true that this is not always the case, because the very material that has been used to mend the broken place may of itself become an irritant and perpetuate the abnormal state. Were it possible to fill an ordinary tooth with something that would be perfectly congenial to the tissues, there is little doubt that all filled teeth would be comfortable, and herein may be found a reason why certain materials, aside from their lasting qualities, make the best fillings.

The test for the perfect success of an operation is the condition of the tissues which ensues,—because recurrent decay is not the first symptom of the failure of an operation. It may be found in the responsiveness of the dentine to external irritants; in its sensitiveness to outward impressions. Not that it is always possible completely to restore to healthy functional activity a tooth that has been subjected to operative filling. Usually only toleration with mild protest can be obtained for the foreign matter that is used for protective purposes, especially if it is of a metallic nature. When there is permanent denudation of any part, as in recession of the gums, normal conditions cannot even be approximated.

One of the causes of the irritation in which is found the source of sensitive dentine is caries. This is of itself a pathological condition of dentine, and its progress necessarily entails other degenerative conditions. The disintegration of portions of the tooth-bone, with the consequent destruction of parts of the dental fibrillæ, must affect that with which it is in connection; and so there will be an irritable, disordered condition of the whole of the dentine, with hypersensitiveness and inflammatory changes in the protoplasmic elements of the soft fibrils, modified in manifestation by the character of the structure itself. With such a destructive, deadly dis-

order as caries working at its vitals, no portion of the structure of a tooth can be in a healthy state, for although teeth have not the complex and vascular formation of the soft tissues, we cannot consider these organs as made up of dead, inert matter.

Denudation of portions of the tooth, its loss of a part of that which should form any of its investing protection, must subject it to unnatural conditions. If the gum has receded at the neck, that simply means that the tooth is exposed to new environments and strange perplexities that cannot be otherwise than exasperating. Under the stress of their provocation it assumes an added susceptibility, and becomes more and more liable to attacks of external agents. All the dentine is thus affected, and it becomes tender, sensitive, responsive to any provocation. This, as in the case of caries, proceeds by continuity of tissue to the pulp, which also becomes irritable and inflamed, so that there is an immediate response to thermal changes, to the presence of acids or sweets, and even to the finger nail or quill toothpick. Metal toothpicks are almost always irritating to the teeth.

Vitiated secretions are also a cause of sensitive dentine. The secretion of the somewhat specialized mucous follicles at the gingival margin is sometimes, through neglect of the teeth and the presence of fermenting *débris*, of a degenerative type. This secretion becomes acid, and in this state is highly irritative to the cervix of the tooth. Or the white deposit which is so frequently found surrounding the tooth at its neck, and which is made up of decomposing matter undergoing fermentation or putrefaction, may be the cause of the irritation. The resulting acid may dissolve out some of the lime salts at the cervix, where the enamel is very thin, and so lay bare the dentine, which will thus be made specially irritable. Some of the most sensitive dentine encountered by the operator is the result of this acid degeneration or formation.

The teeth are sometimes set on edge by the use of acids. This means softening of the superficial portion of the tooth, and a hyperesthesia, or its analogue, of the dentine. The sensation referred to is not a distinct pain, and it usually passes away with the provocation, but it is a definite feeling of responsiveness in dentine. The same kind of impression may be induced by reflex action, when a saw is filed or strong cloth is torn.

CHAPTER XLVI.

TREATMENT OF HYPERSENSITIVE DENTINE.

It has been affirmed that if a tooth that is in a healthy condition is insensitive, a return to that state after diseased action should carry with it freedom from responsiveness. While this may be true, it is not always possible in dental practice to secure this result. In cases of caries it is impossible to induce a healthy state except by excision of the diseased part, as in necrosis of bone; and it is from the pain of that operation that we seek immunity; hence the only hope of the dentist is in securing an artificial anesthesia of the part. This may be readily accomplished, as in the other tissues, by inhibiting and stopping all nervous currents through general anesthesia. But such methods are prohibited by the circumstances of the case. We do not wish to obtund all sensibility, but only to overcome that of a small part.

The ordinary local anesthetics might be employed, and they would completely answer all demands were that which we wish to make insensitive supplied with bloodvessels and nerves. Unfortunately for our object, this is not the case with the teeth. Theirs is not the structure upon which local anesthetics act, and hence the latter are of but doubtful utility. When cocain was first discovered it was believed by many that the dental millennium had surely arrived, but that agent has been found powerless to benumb nonvascular tissues. This class of remedies may therefore be dismissed from consideration, because while they may under certain conditions inhibit nervous currents in tissues that have a nervous supply, they are inefficacious when that is lacking. Cocain will obtund a pulp that is exposed to its influence, but it is ordinarily powerless upon dentine.

We are thus obliged to fall back upon specific remedies, or those whose therapeutic action is not thus limited. We know that the protoplasmic dentinal fibrils, when in an irritable state, or when made responsive by certain pathological conditions, will convey painful impulses along their course and deliver them to the terminal nerve filaments of a more or less inflamed pulp. If, now, these afferent waves of irritation can be cut off at any point before reaching the sentient centers, immunity from pain will thereby be

secured. This can be done by a general anesthetic that paralyzes sensory filaments and trunks, or it could be accomplished by the application of a local anesthetic directly to the pulp itself. Both of these, for reasons already given, are impracticable, and it leaves the work to be done upon the only other connecting link between the dentinal periphery and the brain.

If the dental fibrils themselves can be put in such a state that they will no longer carry impulses to the pulp, that tissue cannot transmit any to the afferent nerves which carry them to the nerve centers.

FIG. 57.

TERMINATION OF THE DENTINAL TUBULI.

a, Enamel; *b*, Dentine; *c*, Line of junction of enamel and dentine,—first calcification of tooth tissue; interglobular spaces. (Andrews.)

There are two ways of accomplishing this, neither of which is entirely satisfactory in its results. The first is by producing some temporary physical change in the character of the fibril that will prevent its receiving an impulse, and the second by subjecting it to some medicinal agent that will paralyze its transmitting function.

There are perhaps two other methods of accomplishing the same thing which should be included in the list of methods to be employed, and they will be duly considered. They are, first, the exercise of such care and gentleness, with the use of such perfected instruments as shall arouse no irritating pain waves; and, second, the employment of such general prophylactic remedies and

measures to fortify the system as will enable it to resist them, or steel it against their reception.

The physical agents which are practicable will be such as will temporarily change the material characteristics of the fibrillæ, and of these the most important are heat and cold.

Heat may act either by raising the temperature above the point of susceptibility,—which is impracticable, because it is of itself a painful process,—or by so changing the matter of the fibrillæ through desiccation, or drying out, as to make them incapable of conveying impulses. It is readily conceivable that, a cavity being isolated by the use of a rubber-dam, a current of hot air may be effectual in so changing the physical structure of a fibril, by abstracting a part of its water, as to debar all reception or transmission of nervous or other impulses. This is perhaps the most simple of all methods for obtunding sensitive dentine.

The use of cold, or refrigeration, will be equally effectual by benumbing or paralyzing the fibrillæ. If an ether or rhigolene spray is directed upon the tooth cavity, or even upon the tooth itself, until the temperature is reduced sufficiently, it will be comparatively irresponsive. This would without doubt be the most perfect obtundent, were it not that the effective use of the agent is of itself too painful in its application. There is also danger that the pulp tissue may be permanently injured through degenerative processes inaugurated by the shock of the cold. A severe inflammation may be the result of the application of the ether spray for too long a time. Hence this agent has never been used for obtunding purposes, except in extreme instances.

The medicinal agents that have been employed in attempts to overcome dentinal hypersensitiveness are almost numberless. General and local anesthetics, stimulants and anodynes, excitants and sedatives, acids and alkalies, with many drugs of altogether indefinite and unknown therapeutic value, have been persistently recommended. The whole matter has generally been one of empiricism. It would seem that, so far as our present knowledge goes, anesthetics, whenever locally applied, have little direct effect upon dentinal tissue. All such remedies have a selective power, and affect nervous tissue alone. The dentinal fibrillæ, while they do not contain any nervous filaments, yet comprise the elements of such tissue; and it cannot be positively affirmed that they are not,

under certain conditions, amenable to anesthetic action. But we know that they are not ordinarily so, and hence the agents referred to have proved as inefficient as might have been anticipated.

Certain sedatives, anodynes, and narcotics, like preparations of opium, cannabis indica, and chloral hydrate, have been effective in certain instances, but it is not at all certain that they did not work through other tissues, and thus act indirectly instead of directly. Some cauterants are effectual, but to a limited depth. Thus nitrate of silver, or chromic acid, or carbolic acid, will obtund, but only to the limited depth to which they reach. They certainly destroy the fibrillæ completely as far as their action extends, but that action is not really obtunding; it is extinction.

In the harmless coagulation of the albuminoid contents of the dental tubuli would seem to lie the surest road to success.

There are coagulating agents that thus obtund, like chloride of zinc, but it is too often at the expense of quite as much suffering as they save, leaving out of consideration the dangers to which the dental pulp is exposed by the use in its proximity of active escharotics. If coagulation could be accomplished without permanent injury to the tooth structure, and would reach deep enough to allow of effective excavation, the agent that accomplished this without pain would be the long-sought desideratum. That drug has not yet been discovered, nor can we be sure that it ever will be. Certain it is that until it is sought for in an intelligent, scientific manner, it will remain a secret; for the illiterate, untaught ignoramuses who have in the past been mainly responsible for the quack preparations sold at an extortionate price, and who have not sufficient pharmacal knowledge to save them from compounding the most glaring chemical incompatibles, are not likely to be the discoverers of that which so many competent men have sought in vain.

Cataphoresis, which is the transfer of medicaments into the deeper parts of tissue through the diffusive power of an electric current, seems to promise something in this direction. It is not recently acquired information that has taught us that when a drug is applied to a tissue upon the positive electrode of a battery, the negative being placed so that the current will traverse the organ to be affected, it will carry with it the remedy; this principle has been quite extensively employed in general medicine, and with good

results. To make the remedy in cataphoric medication effective it is not sufficient to carry it deeply into the dentine; it must be transferred to the pulp itself, and to the accomplishment of this the hard dental tissues present difficulties not met with in other organs, in their relatively low vitality and their comparative impenetrability. Yet practical experience seems to point to the indisputable fact that cataphoric transference does take place, but whether with sufficient readiness and rapidity to make it all that can be desired remains to be definitely established. No one will dispute the assertion that in the cataphoric transference of such topically applied remedies as cocaine and morphine better results have been secured than in any other of the thousand proffered methods of obtunding sensitive dentine. But its employment requires a cumbersome and expensive apparatus, troublesome alike to operator and patient, and its results are by no means uniform. While, therefore, every progressive operator should use it, it is not now to be considered a finality. Its application must be simplified and its effects made positive by further experimentation before it can be so accepted. Good men are investigating it, and it is to be hoped that in it will eventually be found that which is so highly desirable. It cannot be forgotten, however, that good men have before this cried, "Lo, here! Lo, there!" only to meet final disappointment and defeat.

Prophylactics have proved of great service in the dental operating room. They are of sedative nature, and reduce general nervous irritability, thus preventing or obtunding nervous shock. They have not been as much used as their merits demand, because most dentists have either been lacking in the medical knowledge necessary to their most intelligent use, or have not felt themselves warranted in administering general remedies. The first of these causes, if it exists, should be at once removed by study, and the last eliminated by a proper amount of self-confidence. The time for administering such remedies is a few moments before commencing any painful operation, the exact interval depending upon the nature of the drug. A few whiffs of chloroform or ether, not enough to induce any functional disturbance whatever, will frequently be of use, but their influence will not last long. Twenty-five grains of potassium bromide in water will be more persistent, and usually quite as effective. Syrup of lactucarium, in teaspoonful doses, has been employed with good effect; or tincture of belladonna, administering from five to twenty drops.

Sulphate of morphia, in doses of from a quarter to half a grain, has been frequently used, but its action upon some people is a little uncertain. The fluid extract of Jamaica dogwood may be substituted for this, and five to twenty drops given in a little water. The full dose of the drug is from a half to two fluidrams. The author has not for several years been without aromatic spirits of ammonia in his case, and whenever there is unusual nervous irritability he administers from thirty to sixty drops of it in water. If there arises the necessity, a hypodermic dose of from one-eighth to a quarter of a grain of morphine may be given. This is usually effectual in quieting all nervous excitability and making otherwise insupportable operations comparatively tolerable. The proper dose of this drug, combined with atropine or strychnine, may be readily obtained in tablet form, and should always be kept at hand.

Hypodermic medication has not been as much employed in oral practice in the past as it should have been.

But, when all is said and done, the main dependence of the judicious dentist will be upon a gentle hand and sharp instruments. It is barbarous to employ in a sensitive tooth any tool that is not in the best possible order; while the operative dentist who for a moment allows himself to forget the consideration that is due to a sensitive, timid, shrinking patient, who will become in the least degree careless or callous, and thus give unnecessary pain, is unworthy his vocation. In excavating a sensitive tooth he should invariably put on the rubber-dam, and dry out the cavity as far as possible. Then he will find a great deal of relief in the employment of many of the remedies already mentioned, and especially in the use of some of the essential oils, like cassia, cloves, or eucalyptus, securing penetration by means of the hot-air blast. A mixture of equal parts of sulphate of morphia and gum camphor may be found useful for this purpose in some instances. Or he may apply tincture of aconite dilute, or any other favorite remedy, always remembering that its effectiveness will be greatly increased by thoroughly drying the cavity of decay, and by the hot-air current.

For those who wish a cocain preparation that is effective, the following is given. It should not be forgotten that this is a ten per cent. solution, and when used hypodermically less of it should be injected:

℞—Atropine,	$\frac{1}{10}$ grain;
Strophanthine,	⅕ "
Cocain mur.,	50 "
Carbolic acid,	10 "
Oil of caryophyllus,	3 minims;
Dist. water,	1 ounce.

The following formula has been recommended by Professor Peirce as effective:

℞—Cocain mur.,	5 grains;
Carbolic acid,	20 "
Chloroform,	½ dram;
Muriatic acid,	10 minims;
Alcohol,	2 drams.

CHAPTER XLVII.

SECONDARY DENTINE, PULP NODULES, AND CALCIFICATIONS.

These, although different manifestations, are parts of the same process. They have their origin in the same disturbed function. They are the result of deranged neural currents and of some perversion of nutrition which induces a formation of dentine in abnormal quantities or in an anomalous position, through the undue activity of the odontoblast cells under the excitement of just enough of irritation to act as the proper stimulant. All of these products have the general structure of dentine, although it may be considerably modified. (See Fig. 58.) They are not usually found as mere calcific, structureless calculi, but are organized by the unduly excited odontoblast cells, whose normal activity continues through life.

The odontoblasts are not found exclusively upon the periphery of the dental pulp, any more than osteoblasts exist alone in connection with periosteum. The latter may be found inside the body of the bone, and may be the initial points for new growths after operations or accidents. The former may exist or be developed within the pulp tissue, and under the special stimulus that was perhaps responsible for their formation may commence functional activity, with the consequent organization of segregated spicules of dentine, and these may continue to grow until they assume the form

of the usual pulp nodule. Sometimes this form of calcification may begin at many points within the pulp, and may impart to that of a freshly extracted tooth a gritty, sandy sensation when it is rubbed between the finger and the thumb. At other times there is an agglomeration into one or more large concretions.

When the unwonted functional activity is at the peripheral pulp borders, the new formation will probably be attached to and form a kind of hypertrophy of the ordinary dentine of the tooth. Sometimes this will be so continued that it will almost entirely fill

FIG. 58.

FORMATION OF PULP STONES. (Andrews.)

the pulp chamber, and even extend down into the root canal. An examination of an extracted tooth affected with this condition will show by its complete or partial attachment to the normal dentine, or by its independence of it, where was the commencement of the new growth.

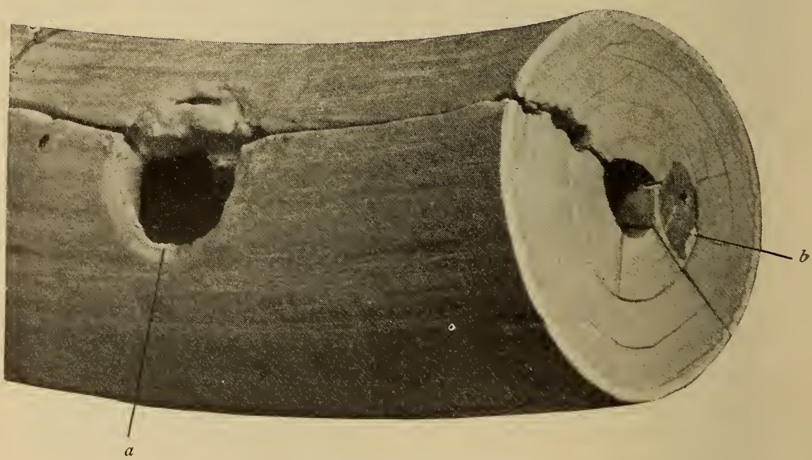
The "pulp stones," or formations of dentine that take place within the substance of the pulp, sometimes contain chambers not unlike the "interglobular spaces" of the tooth. These impart an appearance of bone, and the new formation is analogous to true "osteo-dentine." It may even have open canals that cause it to

assume the appearance of vaso-dentine. As might be inferred from the circumstances under which it is deposited, its structure will be

FIG. 59.

SECONDARY FORMATIONS IN THE TOOTH OF A WHALE.

FIG. 60.

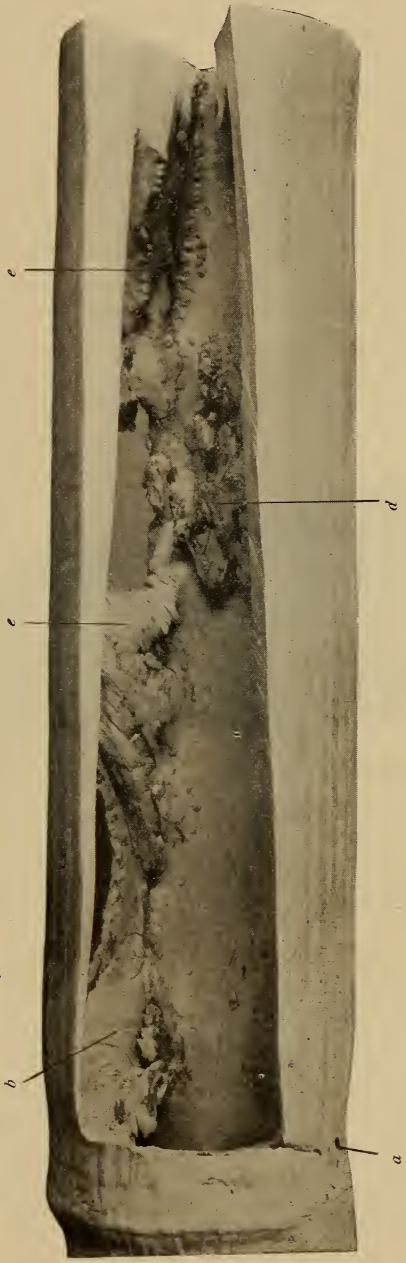


WOUNDED TUSK OF ELEPHANT.

a, Point of entrance of musket ball through the alveolar walls when the animal was young; *b*, The ball carried down and imbedded in the ivory or dentine by the growth of the tusk. (From a specimen in the Buffalo College Museum.)

quite irregular and unmethodical. The canaliculi, or dentinal tubuli, will be involved, convoluted, and irregular. More or less

Fig. 61.



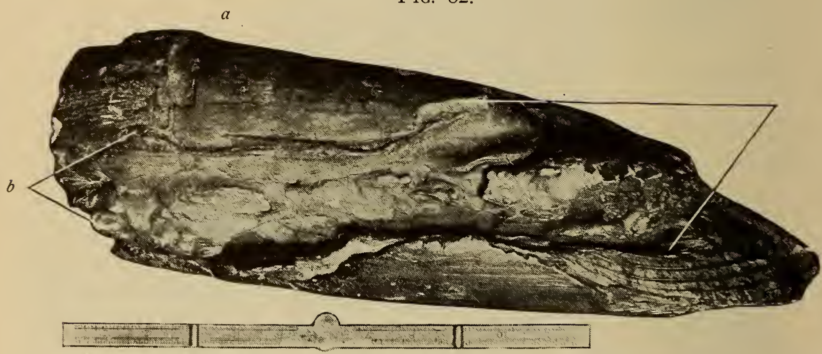
A Representation of the Tusk shown in Fig. 60, with a Section Removed to show Secondary Formations in the Pulp Chamber above the Ball.

a, Cervix of tusk; *b*, *c*, *d*, *e*, Masses of secondary formation.

of the calcified mass may be hyaline, but the structure, when carefully studied, will be found to be essentially dentinal.

The study of comparative dental anatomy will materially assist in a comprehension of these anomalies. In certain animals secondary dentine, or tooth-bone, is very common. This is especially the case with some of the monophyodonts. The persistent pulp chambers of the sperm whale *(Physeter macrocephalus)* are very frequently lined or partially filled with secondary dentinal formations, and some of them make very beautiful objects when polished. (See Fig. 59.) The long incisors of the elephant, the so-called tusks, are frequently wounded by the hunter near their insertion, the bullets remaining in the persistent pulps. This may result in the destruction of the vascular portion of the tooth, but

FIG. 62.



FOSSIL FRAGMENT OF THE TUSK OF *Elephas primigenius*—THE HAIRY MAMMOTH—WHICH HAD BEEN PARTIALLY FRACTURED DURING LIFE AND REPAIRED AND STRENGTHENED BY SECONDARY DEPOSITS.

The fracture was across the base at *a*; the part between the lines at *b* and *c* was a secondary deposit. (From a specimen in the Buffalo College Museum.)

much more frequently the consequence is the deposition about the wound of secondary dentine, which perhaps will entirely inclose and segregate the original cause of irritation, and form septa across the pulp chamber. With the continuous growth of the tooth or tusk this is carried forward, until, perhaps many years subsequently, when the animal is killed and its tusk falls into the hands of the ivory cutters, the original bullet, with the secondary formation about it, is found in the solid ivory, perhaps one or two feet from the skull. (See Figs. 60 and 61.)

Nature sometimes throws out a layer of secondary dentine to protect the pulp from slowly advancing caries, or erosion. The formative cells at the periphery of the threatened portion of the pulp are by the irritation stimulated to increased functional activity, and a kind of hypertrophy of dentine is the result. Practitioners have sometimes seen this take place under a plastic filling that had been inserted over a nearly exposed pulp. In the course of a few years this perhaps became sufficient support for a solidly impacted metal filling. This is the result hoped for in all instances of ordinary capping. Fractured teeth have been known to be united by a secondary growth of dentine, though these instances are probably few in number.

The formation of so-called pulp stones and secondary dentine is a much more common occurrence than is usually imagined. The examinations of the pulp chambers of extracted teeth in the teaching of operative technics in some of the colleges, shows that a considerable proportion of teeth are thus affected. The late Prof. A. P. Southwick, of Buffalo, who was one of the most observant and successful of technic teachers, believed that from sixty to seventy per cent. of extracted teeth show some form of it, but as this applies chiefly to such as have been extracted for diseased conditions, probably it would not hold good universally.

The formations within the pulp chamber are sometimes the cause of considerable local irritation, but neither the objective nor the subjective symptoms of these conditions are sufficiently distinctive to afford reliable means of diagnosis. When they are of rapid growth the pain may be of an acute character, but they do not under ordinary circumstances induce any breaking down of pulp tissue, nor do they bring about any serious complications. Usually the suffering is of that subacute nature that is hardest to locate. It presents no special distinguishing characteristics, and a diagnosis can only be safely made through exclusion. When it is certain that the pain arises from nothing else, it may be attributed to secondary formations. It might, by the superficial observer, readily be mistaken for facial neuralgia, but it is not, like that, paroxysmal or periodical. Nor is it so acute or so intense in its nature.

The presence of pulp stones will not usually be suspected until they are discovered through pulp exposure. Not infrequently they will seriously embarrass the dentist in his efforts at pulp devitali-

zation and extirpation. Sometimes in their presence it is with the utmost difficulty that even arsenous acid can be made to produce its characteristic effect. Why this should be the case to such a marked degree it is impossible to say, as the secondary formation does not usually make an entire septum in the pulp chamber. That it may completely bar the proper filling of the roots of a tooth is more conceivable, for the growth may be so attached to the ordinary dentinal walls as to make its removal very difficult. It may form such an obstruction in a root canal as will absolutely forbid the passage of an instrument. In such instances the Papain digester, as recommended by Professor A. W. Harlan, may be made to serve a specially useful purpose in removing portions of the devitalized dental pulp which are beyond the reach of instruments. In the past there has been no resource save the slow and uncertain process of sloughing, which implies an infected root canal.

The presence of secondary formations, then, will only be positively known when it is too late for anything but removal, when this is practicable. If they are floating in the pulp chamber this will not be a difficult matter. But if they are attached to the dentinal walls it may be impossible. It is not a safe practice to attempt to drill them out, nor in all cases would this materially assist in the subsequent treatment and filling of the root. The operative dentist will be obliged to take them out by enlarging the opening into the pulp chamber when this is practicable, or to use sufficient time thoroughly to sterilize any fragments of remaining pulp tissue, and then to fill as best he can, using some plastic material for the pulp chamber.

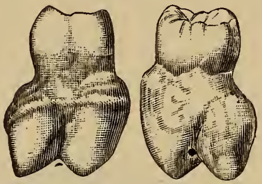
CHAPTER XLVIII.

HYPERCEMENTOSIS.

Hypercementosis is the analogue of hyperostosis, or exostosis, of bone. Technically it is a tumor, but always of benign growth. It is an hypertrophy of the cementum, and has its origin in some form of irritation that is just sufficient to stimulate the pericementum to an abnormal activity. (See Fig. 63.) It may be local, and affect but one tooth, or the irritation and stimulus may be so general as to

induce an excessive deposit of cementum in some form upon all, or nearly all, the teeth of either jaw. (See Fig. 64.) It may even be more comprehensive than that, and involve the osseous tissues. Instances have occurred in which hypercementosis and hyperostosis existed together, with not only enlargement of the roots of all the

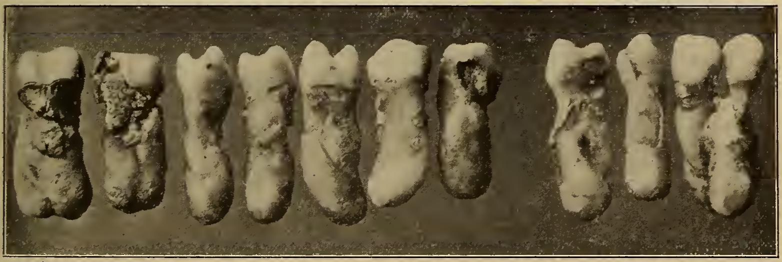
Fig. 63.



Hypercementosis of the Roots of a Lower Molar showing Stimulation of the Entire Pericemental Membrane.

teeth, but of the whole alveolar process of the bone as well. Nodules of exostosed bone may sometimes be felt along the alveolar portions of the lower jaw especially, and these are apt to be associated with expansion of the roots of the teeth from hypercementosis. (See Fig. 65.)

Fig. 64.

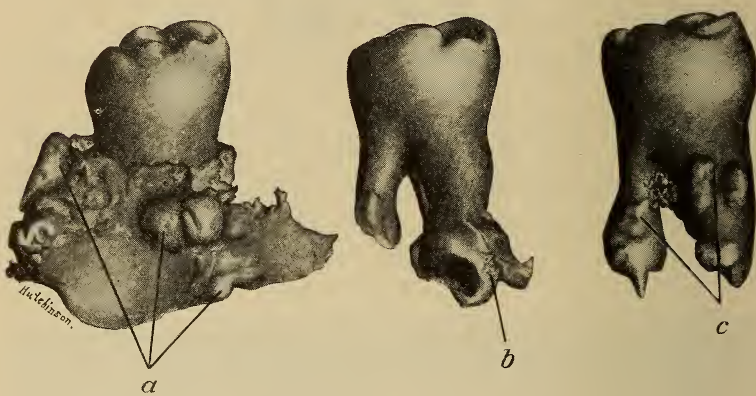


General Pericemental Hyperplasia. Teeth Successively Lost by One Patient. The Two on the Right were Fused together by the Hyperplastic Cementum.
(Practice of Dr. William Jarvie.)

The condition is not one that presents very special pathognomonic symptoms. Unless it is accompanied by hyperostosis, there will be no external indications of its existence. Nor is it provocative of much pain. Hence its diagnosis is at times difficult, or even impossible. There may be a feeling of pressure and general uneasiness in the teeth affected, but it will not be sufficient to furnish a diagnostic sign. There are no special complications, and hence

the condition is not one of great pathological importance. Its chief import to the practicing dentist lies in its being an impediment to extraction, and when that is imperative may make it necessary to cut through the investing alveolar process before the tooth can be lifted out. This will only be called for at the cervical constricted portion above the expanded part of the root. There will have been a resorption of the investing bone sufficient to accommodate the hypertrophy itself, and the cutting through, or removal of a part of the constricted superficial alveolar process is but a simple

Fig. 65.



Nodular Hypercementosis with Accompanying Hyperostosis.

a, Osteophytes upon the external alveolar surface; *b*, Irregular cemental growth, involving both buccal roots; *c*, Cementum nodules. The teeth were so bound together by the interlocking of the cemental growths that all three unavoidably came away together with the exertion of but moderate force, causing an opening into the antrum. (Practice of Dr. G. C. Daboll.)

operation, and is very much preferable to a long struggle to effect expansion in continued efforts to extract the tooth, with the liability to its accidental fracture under the forceps.

Microscopical sections of portions of hypertrophies of the cementum show that they have the true cemental structure, and there is no special line of demarkation visible between the new and the old formation. Pigmentation, or coloring, is not uncommon, its most usual form being a deep yellow or light brown tinge. The cementum corpuscles are often unusually large, so that the nutrition of the hypertrophied and original tissue is very well carried on, for perhaps obvious reasons. A clinical and microscopical study of

the pericementum in these conditions has not hitherto been made. When this is undertaken further light upon this interesting subject will without doubt be afforded.

CHAPTER XLIX.

DISCOLORED TEETH.

WHILE the remedial measures for the relief of discolored teeth belong rather to operative dentistry, and are outside the scope of this work, yet a little may be said concerning the cause of discoloration, which may be due either partially or entirely to pathological conditions. People sometimes present themselves to the dentist with the request that an objectionable color of the whole or parts of the teeth may be discharged, when it is plainly evident that it is congenital. Some people have yellow, and some dark teeth naturally, and no skill is sufficient to alter this without material injury. The leopard cannot change his spots, nor the Ethiopian his skin.

But there are pigmentary deposits upon the surface, and staining which penetrates to a little depth, that it is possible to remove. Of these the most common is the so-called "green stain" so frequently found on the teeth of children, and the analogous brown or reddish-brown pigmentation on those of older growth. It has no special pathologic signification, and may readily be removed by tinct. iodine and pulverized pumice. (See Fig. 39.) Dead dentine, the tubules of which have become filled with pigmentary matter, may be bleached by chemical agents. Usually these deposits, either upon or within the substance of the teeth, are of a yellow or dark color, but in some instances the teeth are turned to a bright blue, or even an intense green. Workers in different metals may have their teeth stained by minute particles. This is especially the case with brass, nickel, and copper workers. When this is superficial it may be readily removed, but when it has penetrated the substance of the tooth it presents greater obstacles.

It is not usually the case that a tooth containing a living pulp is affected by anything beyond mere shallow exterior discoloration. There may be congenitally maculated spots, or atrophied regions

that become pigmented, but any material changes of color are usually associated with a devitalization of the affected tissue. As the consequence of a sharp blow, and sometimes too protracted or severe dental operations, a tooth has been known to assume a bright pink appearance. This is, however, the result of death of the pulp. While the red blood corpuscles are much too large to enter the dentinal tubules, their stroma may be ruptured and the hemoglobin may penetrate the tubuli, giving the red tint. Subsequent changes in this substance may produce a gray or brown color, which finally becomes fixed as a very dark or blackish tint by the action of iron or sulphur. This is more apt to be the case in man than in woman, because the percentage of accidents is somewhat higher. The changes are analogous to those that take place when one has a "black eye," but as there are no absorbents to take up the decomposed blood, it remains a black or dark color.

The dentinal fibrillæ themselves may, instead of being sloughed out, remain, and after desiccation or drying undergo slow retrogressive changes that leave the dentine a dirty yellow or dark brown color. Foreign matter may enter the tubuli, and there slowly become carbonized, and thus form another cause of discoloration. Substances used in filling may impart a stain to the devitalized dentine. Oxidation, or other chemical changes going on in metals used for posts to assist in the retention of fillings, may induce pigmentation more brilliant than ornamental. Thus a piece of copper has been known to impart to a whole crown a beautiful green color, while nickel has given a color approaching turquoise blue.

The most effective means for the discharge of the yellow or dark colors is by the use of chlorine gas. Oxygen is really the active agent, but the most convenient way to generate it is by the use of some preparation that will liberate chlorine gas, and this, in the presence of water, unites with the hydrogen and sets free oxygen, which accomplishes the work. Peroxide of hydrogen and pyrozone, both of which loosely hold in solution an extra volume of oxygen, are also used for the purpose. It is sometimes necessary to repeat the bleaching a number of times, for the discoloration is likely to return until all the colorization changes have ceased.

As it is difficult to force the bleaching agent very far into the dentinal tubuli, it is usual to cut out all the discolored tissue that it

is possible to spare before commencing the process. The bleaching interferes with the integrity of the tissue, and weakens the tooth. Large contour restorations, after this process, are therefore likely to fail; this fact, with the liability to recurrence of the pigmentation, has made crowning rather to be preferred in many cases.

CHAPTER L.

CONGENITAL IMPERFECTIONS OF ENAMEL.

While enamel is organic in the sense that it is the product of function or growth, its proportion of living matter is so small that natural reparative processes or spontaneous degenerative changes are practically impossible. Its proximate principles are inorganic, though of organic origin. In the eruption of the tooth all connection between the enamel and its formative organ is necessarily de-

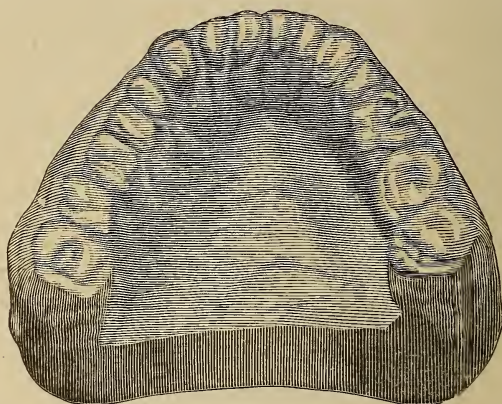
Fig. 66.

Total Lack of Development of the Crowns of the Teeth. Cast of the Upper Jaw of a Young Man. The Peculiarity is the Result of Inheritance.
(From a case in practice.)

stroyed. Its relations are such that there can be no nutritive circulation, and hence practically it can undergo no changes except such as are retrogressive in their nature. And yet, because of its connection with vital tissue, the proportion of living matter in its composition, which though small, is constant, as well as the fact of its genetic origin from bone, of which it is a modification, its consideration as inorganic is forbidden.

These facts indicate that enamel degenerations are not, strictly speaking, pathological, and that their treatment must be from a chemical and mechanical standpoint, rather than from one which is medicinal or vital. By this it is not meant that therapeutic agents are never to be employed, or that special remedies may not sometimes be useful. But such agents should either be directed toward the stimulation of constitutional functional activity, or the neutralization of deleterious products, the result of some vital derangement. Thus general alterative treatment may change the character of environing secretions, or local applications may make them innocuous.

Fig. 67.



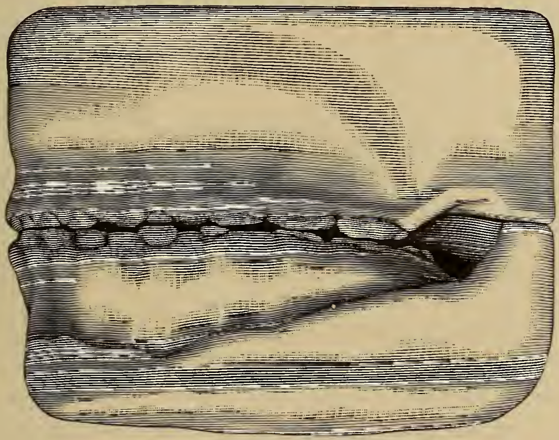
Cast of the Lower Jaw of the Case Represented in Fig. 66. A Very Thin Edge of Enamel Appeared at the Cervical Margins of a Few of the Teeth. There was None upon the Occlusal Surfaces, the Dentine being Exposed and of a Light Amber Color.

The imperfections of enamel may be divided into two classes: those which are formative or natural, and those which are derivative or acquired. The first of these will consist of the structural imperfections produced by aberrant conditions during the process of development, while the latter will be the result of subsequent abnormal and unnatural environments, or the subjection of the teeth to exceptional conditions. The first named will be apparent when the teeth are erupted, while the last will only be observed as a natural effect of the anomalous surrounding circumstances.

It has already been asserted that enamel is a modification of bone, composed of precisely the same elements, though in varied

proportions and modified structure. (See Chapter XXII.). Its growth is a physiological process, and is subject to natural law. Pathological derangements may, however, induce such deflections of nutritive currents, or such structural imperfections in the formative enamel matrix, as may result in defects or faults, or even entire absence of enamel. It is readily conceivable that any functional disturbance of a grave character might bring this about, but as the tissue is of epiblastic origin, any disease which materially involves epithelial structure, it might easily be imagined, would, during the formative period of enamel, leave upon it an indelible

Fig. 68.



Figs. 66 and 67 as They Appeared in Occlusion. The Condition was that which was Natural in this Case and Not the Effect of Wear.

mark. Hence to the eruptive diseases of childhood have been ascribed, correctly or incorrectly, very many of the imperfections which are found in enamel when the tooth is erupted. That this is the sole cause the many varying phenomena would make very improbable, to say the least.

It is sometimes the case that no crown whatever is developed, and instances have been known in which all of the permanent teeth were practically crownless, although the roots were fully grown and of the ordinary size, and the alveolar process was of the usual proportions. Such a case in the practice of the author is represented in Figs. 66, 67, and 68. The peculiarity in this instance was

hereditary, inclining to follow the law of atavism, and, so far as the history could be traced, appearing usually in not more than one individual in any generation. The cementum and dentine of the roots were normal, while the enamel was either wholly lacking or existed but as a friable edge at the cervix of a very few of the teeth.

In this instance, no enamel organ could have developed, or at the best it must have been rudimentary. The results could not have been produced by any eruptive disease, nor any sudden constitutional crisis the result of nutritive changes. The inception of the morbid anatomical condition must have been prenatal, and so the whole was congenital. As in cleft palate, there must have been deficiency in formation, and the plastic organ which should have been the genetic source of enamel growth was either functionless or practically wanting. The absence of an enamel organ would change the whole character of the dental follicle, and the dentinal papilla would be functionless, so far as the development of that part of the dentine which is in relation with the enamel is concerned. But as that tissue is mesoblastic in its origin, when the cementum was organized through the growth of pericementum the function of the dentinal papilla below the crown would not be materially interfered with and the root would present a natural appearance.

That which was general in the instance cited, might in other cases be local or partial, and this would account for the total or limited loss of enamel in individual teeth. Such limitation of the evolution of the enamel organ, or imperfections in it, would be most likely to appear along its internal epithelial border, or that which initiates the process of enamel formation, and hence it is that the incisive portions are those which are most imperfect, while that which is later organized may be quite normal in structure, a condition that is commonly observed in aberrations of the six anterior teeth and the first permanent molar. (See Fig. 69.) The influences may affect the whole enamel, though in a less degree in the later stages of formation. (See Fig. 70 and Fig. 71.)

That the exanthematous diseases may exert a grave influence upon enamel formation few will dispute. They must affect all epithelial tissues, and accordingly, aside from or as a part of the general degeneration that accompanies them, there may be observed

a falling of the hair, with the appearance of atrophied spots, and in some cases furrows in the nails, bearing some analogy to those in the teeth. It would not, however, be anticipated that they would present precisely the same phenomena with those which are

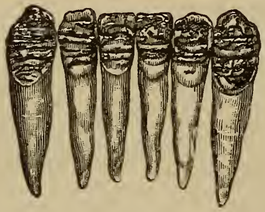
FIG. 69.

FURROWED ENAMEL, WITH MALFORMATIONS OF THE CROWN OF THE TOOTH. (Tomes.)

FIG. 70.

ENTIRE ABSENCE OF THE ENAMEL FROM THAT PART OF THE CROWN THAT IS FIRST FORMED. THAT LATER DEVELOPED IS PERFECT.

FIG. 71.



FURROWED ENAMEL, CONSISTING OF ALTERNATE GROOVES AND RIDGES OF MORE PERFECT TISSUE. (Tomes.)

FIG. 72.

IMPERFECT ENAMEL, SHOWING TWO DISTINCT SERIES OF PITS, WITH PERFECT ENAMEL BETWEEN THEM. (From American System of Dentistry.)

FIG. 73.

IRREGULAR PITS UPON THE CROWNS OF TEETH ASCRIBED TO ERUPTIVE OR EXANTHEMATOUS DISEASES.

congenital in their origin, and so the marks upon enamel produced by the eruptive disorders through which the child may have passed during the period of calcification present indications of the interruption of nutrition, rather than entire absence of

any formative enamel organ. They are confined to the enamel itself, and not at all, or but in a slight degree, affect the dentine beneath. They may exist as a kind of single pitted furrow across the face of the tooth, or there may be more than one such, showing successive attacks. (See Fig. 72.) Not infrequently they may appear as shallow, isolated indentations in the enamel, giving it a rough, uneven appearance, and they bear some analogy to the cutaneous pits produced by smallpox. (See Fig. 73.)

Fig. 74.

Casts of the Edentulous Jaws of a Man of Forty-five Years who Never had either Deciduous or Permanent Teeth. In Addition He was Without Hair on Either Head or Body, was Lacking in the Senses of Taste and Smell, and was Without Any Perspiratory System.

As the degenerations considered in this chapter are either pre-natal in their origin, or are dependent upon general constitutional conditions which produce their characteristic effects before the teeth are erupted, and hence in neither case can be diagnosed or anticipated until they shall have made their appearance, when it is too late for the adoption of any prophylactic measures, no course of treatment, aside from mechanical measures, can be recommended. When the crowns are entirely absent, artificial ones may be engrafted, and when there are imperfections of enamel the roughness may, to a certain extent, be removed by the file or a corundum stone, and afterward carefully polished, or the pits may be filled by the use of gold or porcelain inlays.

CHAPTER LI.

ACQUIRED OR ACCIDENTAL IMPERFECTIONS OF ENAMEL.

The abrasions or erosions of enamel which appear subsequently to the eruption of the teeth must of necessity have a widely different origin from the imperfections that are formative or congenital. As the proportion of living matter in the constituent elements of enamel is proportionally so small, and as there can be no nutritive currents and consequent metabolic changes in structure because of the destruction of the organ which afforded nourishment during growth, any modifications or degenerations of that tissue after it is once formed must be the result of local causes and due

FIG. 75.

1st year. 3d year. 6th year. 7th year. 8th year. 9th year. 10th year. 11th year.
DEVELOPMENT OF THE SUPERIOR CENTRAL INCISORS. (Broomell.)

to environing conditions. There can be no reconstruction of that which has once been lost, nor can there practically be natural recuperation from the effects of diseased conditions. All changes must of necessity be, to all intents and purposes, retrogressive in their nature and the result of extraneous causes.

Aside from caries and the results of accident, the degenerations of formed enamel must result from either attrition or chemical solution. It is not meant to be asserted that theoretically there may not be structural changes, for these naturally inhere to all organic bodies, but practically they must be so infinitesimal in enamel that they cannot be reckoned as a factor worth mention in considering the present subject. That the tissue does undergo

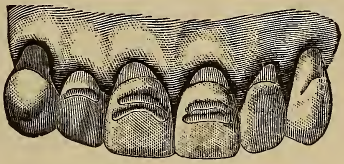
certain superficial modifications, the clinical experience of most experienced dentists will establish. There are times when it seems specially subject to wear and attrition. But as these conditions cannot be the result of functional action, they must be accidental and due to some special state of the oral secretions and fluids.

That which has been denominated "mechanical abrasion," the ordinary wear of teeth, presents no unexplainable phenomena. Certain kinds of food abrade the grinding surfaces of the teeth very fast. Those of the early Indians of the Southwest were, in adult life, usually worn down nearly to the gums by the silicious covering of the corn which formed the principal article of their diet. Among our own people, when mastication must be exclusively done upon the anterior teeth because of loss of the molars, in time the upper incisors are apt to become so worn and channeled as to present the appearance of, and by the laity be mistaken for, "double teeth." The tooth-brush may be responsible for some of that upon the labial aspects, but aside from the evident results of attrition, there appear occasional furrows and concavities that are not congenital and that cannot be the consequence of any usual cause. Sometimes these occur as deep pits in the occluding surface of a molar, without a corresponding protuberance on its antagonist. The channels may be between teeth, where no brush could reach them. They are even found in the teeth of wild and domestic animals, the brush as a necessary cause being thus eliminated. Cases have been known in which upper incisors, for instance, have the appearance of being regularly and evenly chamfered from the cervical portion to the point, as if done with a flat file. In other instances there is a succession of erosive channels or excavations, symmetrical and usually following the line of the gingival border. (See Fig. 76.) One peculiarity of this condition is that the surface left is smooth, and in some instances apparently polished.

Very frequently the excavations are near the margin of the gum, and their edges may be too sharp and well defined to be caused by any common form of attrition, in some instances presenting a distinct undercut. They may be confined to a single one, or may affect a series of teeth. Usually they are found only upon the buccal or labial aspect, occasionally on the proximate,

and very rarely upon the lingual surfaces. They do not seem to be necessarily connected with any special diathesis, for they are found in the teeth of people who show no indications of gout, rheumatism, or any of the diseases to which they have by some been attributed. No explanation has ever yet been presented that will account for all cases of abrasion. Chemical solution by mineral acids is not sufficient, because any acid sufficient to account for the erosion of the surfaces of incisors must manifest itself in other ways; besides, this at times occurs when the reaction of the oral secretions is not strongly acid. It has been attributed to electro-chemical currents which produce electrolysis. The improbability—nay, more, the absolute impossibility—of the existence of such currents in the mouth seems too apparent to need demonstration. There is no

FIG. 76.



EROSION OF THE TEETH. (Darby, from Burchard.)

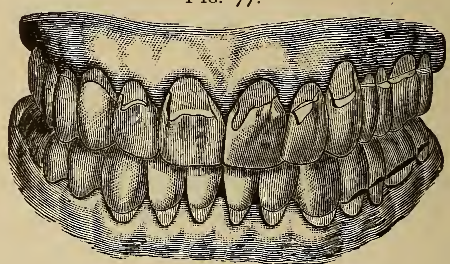
question that electrical currents are constantly being formed by the incessant chemical action and the different molecular changes that never cease in the oral cavity, but it must also be as true that they are as perpetually and as instantly dissipated. There can be no closed circuits, nor any such thing as accumulation; and hence, while theoretically they may be present, practically they must as inevitably be powerless for either good or evil, vanishing on the instant of their birth.

It seems to be true that while the acid reaction in some instances of erosion may be weak, so far as observation goes it always exists. It is well known that organic acids in their nascent state are most active. While, therefore, through fermentation or in a degenerative state of the mucous follicles an acid may by combination be formed in a circumscribed locality, and there, on the spot of its birth, have sufficient force to attack tooth substance, as soon as it becomes diluted and its affinities are partially satisfied it might give but a weak reaction when tested. In this fact may be

found a partial answer to some phenomena. But fermentative acids would not probably be formed upon the most prominent labial surfaces of incisors for instance, where they are most free from any foreign fermentable substance, and where they are constantly washed by the saliva and kept clean by the friction of the lips.

The excavations or cavities formed by erosion bear some analogy to those in certain instances of caries. The loss of tooth substance is as positive, its attacks may be seen in the same localities and the form of the excavation is very like that in some kinds of superficial decay. (See Fig. 77.) But there the resemblance ceases. Both may be the result directly of the decalcifying

FIG. 77.



EROSION OF THE TEETH ON THE LABIO-GINGIVAL AREAS. (Darby, from Burchard.)

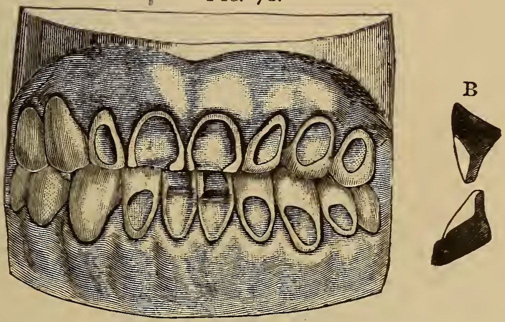
action of some acid, but in caries there is infection and the action of both fermentative and putrefactive organisms, while no septic condition accompanies erosion. In caries there is the formation of minute caverns in the dentine, with subsequent crumbling of the friable tissue, leaving a rough cragged surface, while in erosion the bottom of the excavation is smooth, or even polished. (See Fig. 78.) Miller asserts that even when calcining has removed all the organic material from the tooth, the eroded surface still retains this polished appearance, indicating that essentially the process is very distinct from the minute excavations of caries.

A degenerative, acid condition of the secretions of the specialized mucous glands at the gingival margins might, and probably does, account for some of the peculiar erosion that exists in such localities, but it offers no explanation for that upon the occluding or incisive edges of the teeth. Vital depression, an atonic condition that offers a decreased resistance to degenerative changes, are

terms too vague and indefinite to be accepted as elucidations of such a condition as abrasion.

We are simply reduced to the alternative of accepting explanations that do not explain, or frankly admitting that there is much in this condition which with our present knowledge is not comprehensible. There are factors at work which we probably know not. That it is an external agent of some kind is proven by the fact that a protective filling, when well inserted, always screens the tissue that it covers. The wasting process may go on all about the filling, but it ceases beneath it.

FIG. 78.



EROSION OF THE ENAMEL SURFACES OF THE TEETH EXTENDING INTO THE DENTINE.

b, Profile of the depth of the erosion in the left upper and lower central incisors. (Black, from Burchard.)

In the absence of definite knowledge of the etiology of erosion, any positive prophylactic treatment cannot be laid down. Filling prevents penetration, but it does not in all cases debar extension. It forms the only effective operative treatment that can be pursued, for usually there is no polishing or cleaning to be done. If there is a distinctly acid reaction of the fluids of the mouth it shows that assimilation and nutrition are interfered with, and relief may be found in alterative remedies, and in change of climate, out-of-door exercise, or perhaps the use of tonics. Lime-water may be used as a gargle, and at night a spoonful of Phillips's milk of magnesia may be rinsed about upon the teeth and left there until morning, or until it is slowly dissolved off. Moderate friction of the gums with the brush, and massage with the ball of the finger, are always stimulating and useful.

CHAPTER LII.

REPLANTATION; TRANSPLANTATION; IMPLANTATION.

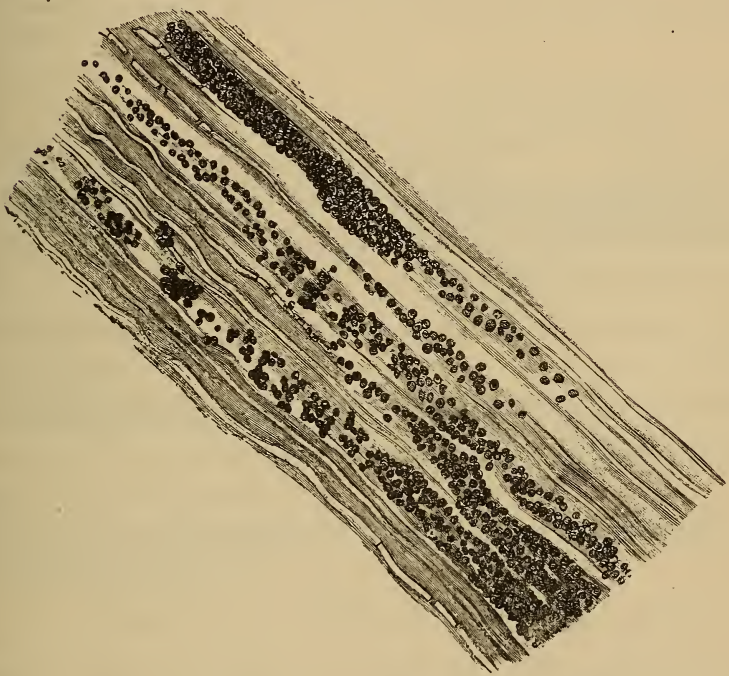
Replantation and transplantation are the insertion of an extracted tooth in a natural, and implantation in an artificial alveolar socket. Replantation is the replacing of a tooth in the same place from which it was, either accidentally or purposely, extracted. Transplantation is the removal of a tooth from one mouth to another. This was originally performed by placing the donor and receiver in the same room, and then extracting a diseased or decayed tooth from the latter and immediately substituting it by one extracted from the former, without any special preparation. But the unfortunate inoculation of a communicable disease in some instances of transplantation brought the operation into disfavor. With the advance in pathological knowledge, more especially that of bacteriology, better methods for its performance have been devised.

Replantation is called for in instances in which teeth have been forced from their investment by accident, or extracted by mistake, or taken out in special conditions. There is no bone that heals so readily as does the alveolar process of the maxilla, and even though there are compound fractures the parts readily unite if nutrition can be kept up in them. A tooth may be knocked out by accident, and may even remain out for a considerable number of hours, and if it is simply washed off and placed back in the socket it may readily unite again. But if no antiseptic precautions are taken the probabilities are that an alveolar abscess will be the consequence.

It is sometimes good practice to extract a tooth with the expectation of replacing it. A broach may have been forced through the foraminal opening, which it has been found impossible to remove. In a number of such instances that have presented themselves to the author, he has promptly extracted, removed the broach, given proper treatment, and reinserted the tooth, always, so far as he knows, with success. Cases of persistent and unaccountable pain that was located in the tooth have been so remedied. In instances of incurable alveolar abscess, perhaps due to secondarily infected pockets, or to foci of infection along the

side of the root where there were nutritive canals penetrating to the pulp through the dentine, or in which the inflammation was of that low, indolent, subacute nature in which neither resolution nor active suppuration could by any usual means be brought about, the author has frequently extracted the tooth, and after proper treatment and preparation replaced it. Sometimes the mere trau-

FIG. 79.



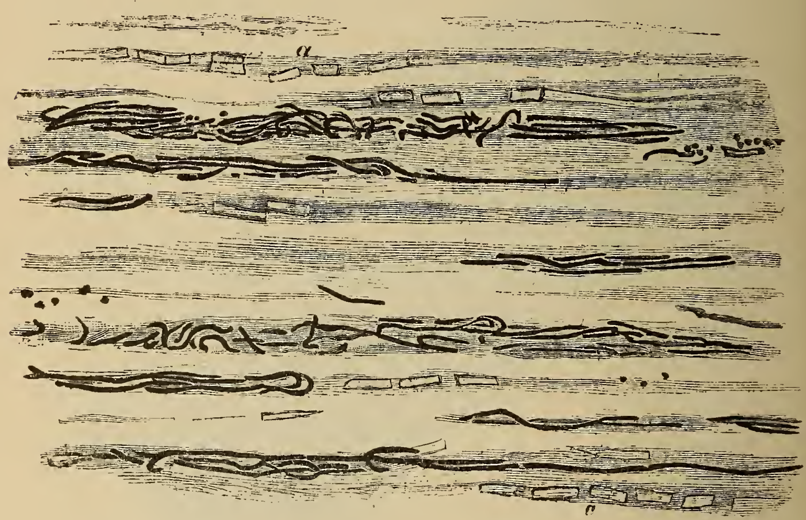
PENETRATION OF COCCUS FORMS INTO THE TUBULES OF A REPLANTED TOOTH, SHOWING THAT THE PROCESS OF DECAY DOES NOT MATERIALLY DIFFER FROM ORDINARY CARIES. (Miller. Compare with Fig. 19.)

matism of the extraction was sufficient to induce an active, acute inflammatory stage, in place of the sluggish one. The possible contingencies are such, however, that this method of treatment is only recommended as a last resort when all other means of relief shall have failed.

In all cases of plantation the most careful antiseptic measures must be employed. When the tooth is extracted, or as soon as

possible after its violent removal by accident, it should be placed in a warm bichloride of mercury solution for sterilization. It should be handled with a clean napkin, and in any subsequent manipulation should be frequently returned to the sterilizing solution, which may be kept warm by placing the vessel containing it in a larger one holding warm water. The pulp chamber should be drilled open, and its contents, with those of the root canals, carefully removed. After sterilization and drying they should be thoroughly filled, any openings, foraminal or through the body of

Fig. 80.



Invasion of Rod and Thread Forms in Replanted Tooth.
At *a* is shown the well-known "pipe-stem" appearance. (Miller.)

the root, being especially looked to. The apex must be made smooth, and if the tooth ends in a sharp point it is well to cut this off, carefully polishing the exposed extremity. If the pericementum which comes away with the tooth appears red and congested, it should be removed without any injury to the tooth itself.

Placing the prepared tooth in the sterilizing solution, attention should now be directed to the socket. This must be thoroughly washed out by syringing with an antiseptic solution, either of the mercuric chlorid 1 : 2000, or some other effective one. If pus is present, a disinfectant like peroxide of hydrogen or

pyrozone should first be used. All these should be employed at blood temperature, or about 100° F. If there is any specially septic condition the alveolar socket should be minutely examined with a probe, to determine the existence of secondary pockets, which should be thoroughly sterilized.

If it is a case of transplantation, the tooth should now be tried in the socket, when if necessary the latter may be deepened or enlarged. No fear of any specially threatening consequences need be entertained, because the formation of new bone is probable and desirable.

When everything is ready the tooth should be taken from the sterilizing solution, and quickly and firmly carried to place. A little subsequent pain is to be expected, because of the presence of fluids in the socket; these will be gradually absorbed into the tissues. Care must be taken that the tooth shall not, for a few days, occlude with any antagonist, and thus keep up an irritation. It must be held firmly immovable by some specially devised apparatus, or by the use of a ligature woven about the planted tooth and a few of the adjoining teeth.

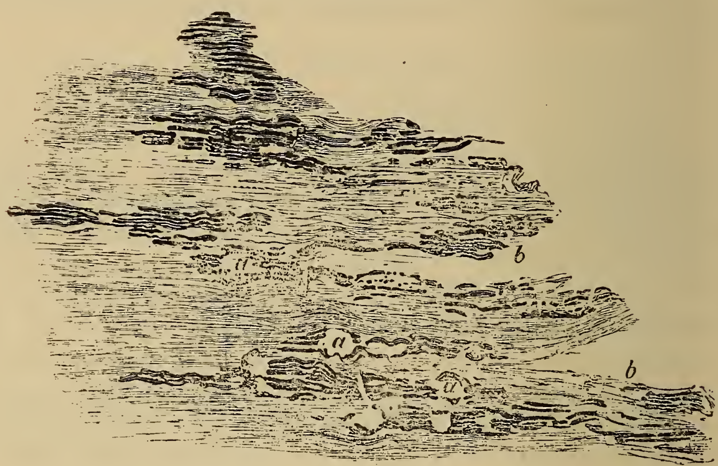
It is surprising how well the ligature, when skillfully adjusted, will hold a tooth. No surgeon would attempt to reduce a fracture and then neglect the adjustment of a splint to hold everything immovable. The ligature is frequently the best splint that can be employed for loose teeth. Kowarski's paste, made of powdered celluloid and acetone, will hold the ligatures in position and form a very efficient and lasting aid in the work.

The only subsequent treatment necessary will usually be to see that all remains aseptic. If necessary, careful irrigation with a sterilizing solution should be kept up until new tissue has begun to form. If there is the least sign of infection, or of breaking down, it is usually better to remove the tooth, search for any irritants, more carefully sterilize, and insert it again.

Implantation has become an accepted method of practice with many oral surgeons. It had been successfully performed, but public attention was never specially called to it until Dr. W. J. Younger repeatedly demonstrated its entire practicability. The operation consists in the forming of an artificial socket in the alveolar process, and the insertion into it of a tooth previously extracted. Nor is it essential, although it is advisable, that the

implanted tooth shall have been recently extracted. Successful operations have been made with teeth that have been lying about the office for years. A very superficial comprehension of the conditions involved will, however, convince any one that such an operation will give very much less promise of permanence than when a tooth not full of cracks and checks is selected. It does not need much physiological or pathological knowledge to demon-

Fig. 81.



Longitudinal Section of Decayed Dentine from a Replanted Tooth, showing the Distended Tubules.

a, Liquefaction caverns. *b*, Rents due to the advanced stage of decomposition of the dentine. (Miller.)

strate that, other things being equal, the better and fresher the tooth to be implanted the greater the chances for lasting success.

The first thing, when implantation is contemplated, is the selection of a tooth. This should be done with an eye to temperament, size, and form. The proportion of the length and thickness of the root to the depth and breadth of the alveolar process should be observed, so that proper adjustment may be possible. The directions given for the proper preparation of a tooth for replantation are applicable to cases of implantation, and need not be repeated.

The formation of the artificial socket in the alveolar process is done by laying back the gum and periosteum from the selected

place, through the means of a crucial incision. Then with the proper instruments the socket is cut to a sufficient depth and enlarged as is necessary, the previously prepared tooth being occasionally lifted from the sterilizing solution in which it should be kept, and tried in to determine the direction, as well as the depth and size of the hole, which should not be so large as to permit the root to be loose. Finally, the tooth is inserted, and a proper splint or ligature used to hold it immovable. If it does not readily and quickly become attached and within three or four days appear comparatively firm, it is better to remove it, freshen the walls of the socket with the bur, sterilize it again and replant it; or, what is better, obtain another tooth and insert that after its proper preparation.

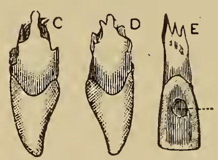
The operation is really but a simple one, as there are not likely to be any complications, unless in very rare cases tetanus might be induced. Should there be any indications of this, ten to fifteen drops of belladonna may be administered every four hours. Care should be exercised about drilling too deeply and thus severing arteries or nerves that might be avoided. No one should attempt the operation unless he is thoroughly familiar with the anatomy of the parts, for it is possible to do serious injury.

The point of greatest interest lies in the possibility of permanent attachment and the character of the changes that are involved. It does not seem possible that there can be any revivification of tissues that perhaps have long been dead. As for the enamel, the proportion of living matter it contains is too small to be taken into account. The dentine is in precisely the same state as in other devitalized teeth in which the root canal has been successfully filled. It is not at all in relation with any of the other tissues of the body, being completely enveloped and segregated by the overlying enamel and cementum. The latter tissue, and the pericementum, are the only ones to be considered, and a little examination into their probable state may be profitable.

The studies of implanted or replanted teeth made after they have been subsequently lost reveal no conditions that may not exist in those remaining in their natural sockets. They may be attacked by caries which will not materially differ from that of ordinary devitalized teeth. Into the tubules of their dentine

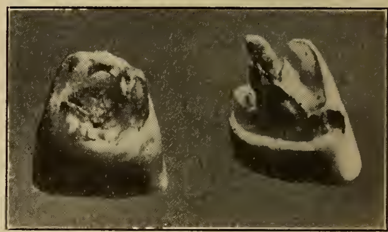
organisms may penetrate, as in other instances of tooth infection. (See Fig. 79.) There may be melting down of the intertubular substance, distention of the tubuli and destruction of the dentine as in the usual forms of caries. (See Fig. 80.) The same minute caverns and liquefaction foci are formed, with the fracturing and breaking up of the weakened tissue, that may be observed in teeth that have never been extracted. (See Fig. 81.) When they are lost through resorption of the cementum and dentine of the root, the appearances indicate that it is a process identical with that by which the roots of deciduous teeth are removed—the action of the osteoclasts or resorption cells that are formed. (See Figs. 82 and 83.)

Fig. 82.



Resorption of the Roots of Deciduous Teeth as Usually Observed.

Fig. 83.



Resorption of Implanted Tooth, showing Labial and Lingual Aspects.

In the latter the projecting central portion is the gutta-percha root filling. (Practice of Dr. William Jarvie.)

In all cases of plantation of teeth the final success of the operation must depend either upon the reunion of sundered tissues or the growing of new. Osteoblasts may exist anywhere in the substance of the bone, or may be developed at any point where the artificial socket is made. Some of them must necessarily be encountered, and they will serve as the initial points for the growth of new bone. A new periosteum (or in this case pericementum) must be developed to form the nutritive organ of the new tissue. The inflammation developed by the trauma results in the effusion of the lymph necessary for these new growths, and thus the cavities in the bone are filled with granulations as the consequence of the development of a new pericemental membrane. Without the growth of new pericementum it is difficult to imagine either the formation of new tissue or the nutrition of that already

in existence. Under favoring conditions this is as readily organized as any other tissue, and it would appear that its formation must be the initial step in all these conditions.

Thus we can readily account for the reconstruction of pericementum and bone. The cementum of the tooth structure is already formed. No instances of any further growths to it in these cases have been brought to professional notice. If any such do exist they must appear as hypertrophies, brought about through the formation of cementoblast cells and their physiological activity, a process that does not seem probable. Osteoblasts may be found, for there is living bone, but there is no vivified cementum.

It does not appear probable that the attachment of an implanted tooth can be by anything like ankylosis, as has been sometimes urged. Only homologous tissues will unite, and bone and cementum are too widely differentiated ever to grow together. Any such kind of ankylosis, then, must imply the formation of some agglutinating substance which partakes of the structure of both tissues, and which might become continuous with the bone on one side and unite with the cementum on the other. But we know of no such kind of hybrid or mongrel tissue, nor has any case of such union been demonstrated. It is true that fractured bones are joined by the deposition of "provisional callus," but that is formed, unlike osseous tissues which have a membranous genetic origin, through the calcification of a cartilaginous matrix, while this organization of new tissue must be under the domination of the pericemental membrane.

If there could be formed any ankylosing tissue, it could be but temporary, because without a pericementum there would be no means by which it could be sufficiently nourished, and it must shortly break down. But it is as true that pericementum may be secondarily formed after its destruction as that any other tissue may be grown after its partial loss. While it is a fact that no new cementum is added to the tooth, nor can the cementum corpuscles be revivified, yet cavities in the investing bone may be filled through the action of osteoblasts, and these would imply the formation of a new periosteum or pericementum, without which necrosis would be the probable result. All the circumstances attending the attachment of an implanted tooth, and those of its loss after such fixation,

seem unmistakably to point to the formation of a new pericementum and the penetration of the cementum of the implanted tooth by the fibers of Sharpey, or their analogues, as in teeth of natural growth.

What, then, is the probable condition of the cementum of an implanted tooth that had for a long time been extracted? Such examinations as it has been possible to make in the implanted teeth that have been lost and then have fallen under observation, have indicated resorption rather than growth. It does not appear that the cementum lacunæ have ever been refilled with living matter, but that the extent of revivification has been the penetration of the cementum by the transverse fibers of the pericementum, which thus holds the tooth firmly in place, for a time at least, and preserves it from retrogressive changes. Under these circumstances that which might naturally be expected too often takes place, and any unusual irritation, or perhaps some nutritional derangement, results in the formation of osteoclasts, with the resorption of the cementum. This is the usual process by which an implanted tooth is lost. There being no formation of living matter within the cementum cells, but simply the penetration of the pericemental fibers, the tooth only remains in a state of tolerance. The usual period of retention, when the work is skillfully done, is sufficient, however, to justify the operation, when no special service is demanded aside from the preservation of appearances.

CHAPTER LIII.

SYPHILIS: GENERAL CONSIDERATIONS.

The introduction of the study of diseases like Syphilis in a book of this character may, by the advocates of a restricted dental practice, be thought quite outside its scope. Were it a strictly venereal disorder this would be quite true. But when we reflect that some of the gravest manifestations of syphilis are in the oral cavity, and remember that many of them are highly infectious, and that the danger to the dentist himself as well as to succeeding innocent patients is extreme unless intelligent precautions are taken, the absolute necessity for a comprehension of the nature of the symptoms manifested becomes at once apparent. The average

dentist has heard and read of the fearful consequences that may be the result of operations for syphilitic patients, but he has not

FIG. 84.

CHANCRE IN THE PALM.

The subject is a dentist who gives a unique history. He injured his hand a month previous to the appearance of the chancre, while filling a tooth with gold. A plugger held in the unaffected hand suddenly slipped, causing a slight abrasion. This healed in a few days, but subsequently developed into the condition shown in the photograph. The lesion was about the size of a hazelnut, well raised, with a surrounding area of induration, covered in part with pale granulations. The axillary glands and those at the elbow were enlarged. Later on a roseola appeared in the trunk. (Dr. Grover W. Wende.)

the knowledge that would enable him to recognize a case when presented, or to distinguish between such exhibitions of its viru-

lence as are dangerous and those which are entirely harmless and non-infective. He looks with suspicion upon any sore in the mouth, and shrinks from a simple aphthous spot as involuntarily as he would from a pernicious mucous plaque.

On the other hand, his ignorance may permit him to exhibit the most reprehensible recklessness, and not recognizing upon a poisoned instrument that which is deadly in its nature, carry infection to some innocent child, and inoculate it for that which shall blast its whole future life. Dr. G. W. Wende, of Buffalo, has in his large collection of photographs of cases of syphilitic infection representations of some most pitiable instances of the inoculation of dentists and surgeons when operating (see Fig. 84), of chancres produced in children through kissing, of others upon the faces of patients through the prick of a dentist's excavator, infections by means of drinking glasses and through other unusual and unsuspected channels. The importance to the dentist, then, of a careful study, especially of the oral manifestations of syphilitic infection, cannot well be over-estimated. Nor can he comprehend the significance of these without some knowledge of the character and progress of the disorder. Hence the inclusion of some instruction in syphilitic degenerations should form a part of the curriculum of dental study.

The introduction of the minutest amount of the discharge from a syphilitic sore, in certain stages of the disease, will inevitably produce the chancre which is the initial lesion. Nothing short of complete asepticism will prevent this, nor will any subsequent sterilization neutralize the poison when once it has gained entrance. Anything, no matter what, which will carry this deadly virus, may be the cause of inoculation. It may not even be essential to pierce the epidermis. Any accidental sore, or fissure, or abrasion, may afford entrance to the specific organism, and hence there is no absolute safety from infection from a syphilitic sore, save by the most rigid sterilization of everything brought in contact with it, or with fluids or matter infected by it. And yet, surgeons and dentists are constantly operating for syphilitic patients without being inoculated. There is really no great danger to the operator provided he observes proper precautions. The author has frequently worked for patients with infective plaques in the mouth, without apprehension. He always, however, uses

a set of instruments that are never employed for other patients, and he will not subject those like the dental engine to the risk of infection. After such operations, napkins, rubber dam, etc., are burned, while everything else used is subjected to careful sterilization.

There are certain stages in which syphilitic discharges are quite non-infective. There are others in which the danger, while possible, is very remote, and yet others in which the slightest inoculation is positive and certain. And not only may the discharge from the syphilitic sore be infective, but the very blood of the syphilitic patient may be poisonous, and a single drop of it may produce a true chancre. The secretion from a mucous plaque may be mixed with the saliva and that be made the medium of infection. Hence, in the infectious stages of acquired syphilis, prophylaxis is of far greater importance in the mouth than in any other anatomical region. In inherited tertiary syphilis there may exist the most repulsive and apparently threatening sores, yet they are wholly non-infectious. In the acquired tertiary form, while there may exist the possibility of infection, the danger is very slight. Some of the lesions of the secondary stage are as infectious as the primary sore, but the ordinary eruptions are harmless. The initial lesion of primary syphilis, the true chancre, no matter what may be its location, is always deadly and its discharge inevitably infective. Such apparently contradictory conditions demand technical knowledge of the disease if the practitioner is to know when and how to operate with safety to himself and to others.

The oral lesions that are dangerous, aside from the primary chancre, which may appear upon the lip or in the mouth, belong to the secondary, the eruptive stage, and consist of the degenerations of mucous membrane that are analogous to those taking place in the skin. They do not essentially differ from the eruptions on other parts of the body, but are merely modified by the conditions existing in the tissues in which they appear. Mucous membrane is the covering of the internal parts of the body, as the skin is of those which are external. Each is continuous with the other, has nearly the same structure, and has like functions. Both are covered with epithelial scales, which are continually exfoliated and as constantly renewed. But in place of the sebaceous and

perspiratory glands of the skin, the mucous membrane has mucous follicles, whose secretion keeps it in a moist condition.

An eruption due to an identical cause may present a far different appearance on mucous membrane from that exhibited upon the external cuticle. In the mouth, where the secretion of the salivary glands is added to that from the mucous follicles, this variation is very much intensified, and an eruption which upón the skin might present the appearance of nothing more than maculated spots may here exist as erosions. Another, which in the same stage upon the skin would present the form of a simple papule, in the mouth is macerated and softened and irritated until the papules break down and appear as mucous plaques. This must be heedfully kept in mind by the student, who should not forget that the existence of a cutaneous eruption will be likely to appear in the oral cavity as mucous plaques and eroded patches. The presence of the former should always prompt the practitioner to look in the mouth for the latter. It is impossible in a work like this to afford anything like an exhaustive study of the subject, but the author will endeavor to summarize the most salient points, before proceeding to which he has thought it necessary to present these general remarks.

CHAPTER LIV.

SYPHILIS: THE PRIMARY STAGE.

Syphilis is a constitutional, infectious disease, which may be acquired by direct contact or transmitted by a tainted parent to the child, and so received by inheritance. The virus is exceedingly virulent in character, and in time affects every tissue of the body, even to the hair and nails. It is believed to be due to a specific organism, though none has been positively identified. As has been already said, while usually a venereal disease acquired by sexual congress, it may be communicated to any abraded surface by any agent that will convey the virus. The primary sore may be upon the lips of the person affected, and he or she may communicate it by kissing, or it may be carried by surgeons' or dentists' instruments, or even by drinking vessels.

While the most malignant of diseases, there is none which so

directly and unmistakably yields to properly directed medication. It is the belief of many physicians that drugs have no curative power, but that all recovery from diseased conditions is due to functional activities, and that medicines can do no more than to fortify nature to support vitality, to invigorate function. The fact that syphilis is positively curable by medication, that it is indisputably amenable to specific agents, is the insuperable obstacle to the acceptance of the dogma that drugs have no immediate remedial action, but that all cures are through the *vis medicatrix naturæ*—the recuperative or healing force inherent in function.

It is only when acquired by inoculation that syphilis presents all its characteristic phenomena. When it is congenital, *i.e.*, inherited from syphilitic parents, it does not pass through all the incubative stages, and is without the initial lesion or sore. Our attention therefore will primarily be directed to acquired syphilis.

The primary sore which is produced by inoculation with the syphilitic virus is called the Chancre. It is located at the point of infection, and is single. (See Fig. 84.) It does not make its appearance immediately after infection, but there is a period which varies in length from ten to sixty days, during which the specific virus is insensibly working, before an unmistakable lesion is seen. This is called "the period of first incubation."

The chancre, or primary sore, presents certain characteristics which, while not affording an infallible criterion in diagnosis as to its nature, yet when linked with the whole clinical history should prevent any egregious errors. But it should not at once be suspected that every sore in the mouth, upon the lips, or even the genitals, is of syphilitic origin, without confirmatory testimony. Many an innocent person has rested under suspicion because of the appearance of a papule, vesicle, or pustule upon some portion of the body. Dentists should be especially careful in their deductions, and should not precipitately pronounce a lesion "specific" until it is unmistakably proved such.

It is a very delicate matter for a practitioner to whom application for professional services is made by a respectable person, in whose mouth or upon whose lips there exists a suspicious sore, to ask any pointed questions as to its origin. And yet it is of the utmost importance, not only to the dentist personally, but to his

other patients, that he should know the truth. He cannot commence any special inquiries until he has something definite upon which to found them, for an innocent person is likely to consider it a mortal offense if he or she is suspected of infection with so loathsome a disorder. Fortunately, it is not usual for lesions to make their appearance in or about the mouth until the existence of the disease is well known to the patient, and before that time arrives he or she has probably been under the care of a physician. Knowing the exigencies of the case, they will then in most instances be ready to respond at once to guarded inquiries. But it should be comprehended that these remarks do not apply when the chancre originally appears about the mouth. It is only when the oral indications are secondary that the patient himself will comprehend their character and significance.

The first prerequisite to the identification of a syphilitic sore will be found in the history of the case. If it appears upon the genitals, there must have been an exposure through an impure connection. It is needless to say that while the physician patiently listens, without expressing any dissent, to tales of water-closet infection, he will in his mind give them just the weight to which they are entitled. If the primary sore appears about the mouth there must have been a history of infection in some way, and that may be even less creditable than when the inoculation is through natural sexual intercourse. On the other hand, it may be by entirely innocent means. It may tax the ingenuity of the practitioner to discover some way in which to determine this point.

The chancre, which is positively indicative of syphilitic poisoning, presents these three distinguishing features:

a. An incubative period preceding its appearance.

b. Certain special characteristic appearances.

c. Glandular enlargements and indurations.

The period of incubation, as has already been stated, is an average of about twenty-one days. But it should not be understood that symptoms of infection will always manifest themselves after exposure. Some people seem to have almost an entire immunity to ordinary inoculation, and may escape when another would not. There are conditions of the system in which one is more liable to infection than in others, as is the case with other communicable disorders, so that a person may possibly pass through the

fire more than once without being burned. Very old and very young persons are especially liable to infection, because of their weak resisting powers; and the same may be said in anemia, malaria, alcoholism, and other atonic conditions.

The first appearance of the chancre is usually as some kind of a papilla or pimple situated at the point of infection and varying in

FIG. 85.

CHANCRE ON THE UPPER LIP. COMMENCING TO ULCERATE. (Wende.)

size. It may never be large enough to attract special attention, but usually it continues to increase until it is as large as a dime. It is dark in color, elevated very little above the general surface, and is imbedded in an indurated, subcutaneous, infiltrated mass, which between the thumb and finger feels like cartilage. This hard base, with the entire absence of pain, burning, itching or fever, and with the glandular affection which is soon manifest,

may be considered pathognomonic of the syphilitic infection. After about ten days the epithelia upon the surface of the chancre softens and it becomes covered with a gray film. Then the central point ulcerates and discharges a serum which is highly infectious. (See Fig. 85.)

Very soon after the appearance of the chancre the nearest lymphatic glands become enlarged and indurated, thus indicating the beginning of the constitutional affection. If the primary inoculation is venereal, the inguinal glands will be the ones first attacked, and form what is called the indolent bubo. A gland may even break down and suppurate, and cause an ulcerative bubo. If the initial point of lesion is about the mouth, the sub-maxillary salivary gland is affected, and may be felt as a swollen hard lump beneath the jaw. A little later the cervical lymphatics become engaged, and may be felt, or even seen, presenting their characteristic appearance. In suspected chancre of the lip the condition of the sub-maxillary gland will be a great help in making a diagnosis.

The chancre is single. The instances in which two or more appear are very rare. It is not auto-inoculable, and in this respect materially differs from chancroid, or false chancre. It usually heals readily, without any scar or deep mark, and that without special local treatment. The time of its duration is somewhat uncertain, and depends upon the type which the disease assumes. Very young and very old persons are likely to be more violently attacked, and the chancre may in these instances persist longer. The same may be said of atonic and anemic individuals, or those suffering from tuberculosis, malaria, or alcoholism. In these cases the whole affection is likely to assume a malignant type, and the sore may continue until the appearance of the secondary symptoms.

In the primary stages mercury seems almost a specific, and if the system will bear it in sufficient quantities the progress of the infection is stayed. Sometimes, however, this remedy produces such derangements that it is impossible to continue its free use, and the doses must be reduced. Ptyalism with intense glossitis may supervene, and other general disturbances may be of such a grave character that it will be found imprudent to push it sufficiently to neutralize the virus completely. The chancre should be treated antiseptically, and if necessary cauterized to hasten the healing.

CHAPTER LV.

THE SECONDARY STAGE OF SYPHILIS.

With the disappearance of the primary sore commences the second period of incubation, or that in which the virus is insidiously but steadily invading all the tissues of the body. This period, like the first, is variable, and may extend from three weeks to six months, or even more, seven weeks being about the average. At the end of that time there commences a train of symptoms which denote that the infection has passed beyond the local stage, and through the lymph channels has reached every organ and tissue of the body. During this second period of incubation the uninformed victim might imagine the disease cured, but that is by no means the case. The virus is very active, though without any outward manifestations, until it exhibits its destructive energy in constitutional symptoms.

The indication of the completion of the second period of incubation and the commencement of the second stage of syphilis is the appearance of the so-called syphilides, or syphilodermata. These are the eruptions of various kinds which appear upon different parts of the body. The first of these is most commonly a kind of roseola, or redness of the skin, which covers the thorax, occasionally the abdomen, and sometimes nearly the whole body, very rarely appearing on the face. It is symmetrical, occurring on both sides of the median line alike, and not coming as irregular desultory blotches. Like the chancre, which marks the primary stage, this eruption is without any functional disturbance, and in this absence of burning or itching or fever differs from all other skin eruptions. The roseola is entirely superficial and spontaneously disappears after a variable period, to be succeeded by other forms of eruption.

The syphilides of the secondary stage appear on both the skin and the mucous membrane, and may be erythematous (red blotches), macular (pigmented spots), squamous (scaly), vesicular (sac-like), pustular (pimples), tubercular (nodules), rupial (crusts), or they may assume any intermediate form. The syphilitic sore throat, which usually accompanies any of these forms, is really the eruption upon the mucous membrane of the pharynx.

The mucous plaques, or mucous patches of the mouth, are the same eruptions, changed in their appearance by the character of the tissue in which they are manifested, and by their environments or surroundings.

For the purposes demanded by the present study all the syphilides may be divided into three classes—the macular, the papular,

FIG. 86.

MUCOUS PLAQUE OR PATCH (PAPULO-EROSIVE PLAQUE) UPON THE TONGUE. (Wende.)

and the pustular. The first when they appear upon external cutaneous surfaces are primarily only pigmented spots, like freckles, not raised above the surrounding tissues, tending to circular groupings, and of a coppery color. They may entirely disappear and be succeeded by, or they may assume, the papillary form, and spread. They appear innocent and give the patient no inconvenience.

In the mouth and upon mucous membrane the eruption is usually first seen in this macular form,—that is, of reddish or copper colored spots, not raised above contiguous surfaces. They may be observed over the arch of the soft palate, upon the tongue and pillars of the fauces, on the buccal surfaces, and along the mucous membrane where it doubles upon itself and where it is hidden from ordinary observation. Especially are they apt to appear beneath the tongue and upon the folds of the membrane in that locality. They may be the size of the finger nail or they may be mere punctate spots. Usually they very soon disappear and are succeeded by the papules.

The papular form is that which succeeds the macular. It consists of reddish pimples appearing upon the skin, which from a single point spread, or from a number such become confluent. Gradually these papules become more pronounced and separate, certain of them perhaps degenerating and assuming an aggravated appearance, while between them the others disappear or become scaly, the surface being exfoliated, and so the eruption takes upon itself the third or pustular form. This is the most common manner of progression, but in some malignant instances the macular seems very quickly to degenerate into the pustules, without the appearance of papules.

In the mouth the papular form assumes different characteristics. Instead of gradually becoming pustular, the surfaces are macerated in the oral fluids and soon appear as erosions. There is an infiltration into the sub-mucous tissue, and this causes a raising of the edges, while the sore is imbedded in a stroma of the thickened, slightly sclerotic base. The center softens and is covered with a grayish film, which discharges a sanious, highly infective fluid. This sore will have sharply defined edges, a dark red aureola surrounding it, an excavated surface and a crater-like general aspect, with necrotic tissue on or in it, when seen in its worst phases. In less pronounced cases it may be only a round or ovoid sore of a yellowish color, no aureola, with but a slight excavation and a discharge which is not as profuse, but is quite as infectious as is the other.

The appearances described in the preceding paragraph form what are called the "mucous plaques" or "mucous patches" of secondary syphilis. (See Fig. 86.) They are the oral syphilides

which the dentist should most carefully guard against. They will most frequently be observed on the borders of the tongue, but may be found anywhere on the oral mucous membrane, the uvula, in the pharynx, and where two surfaces come in contact. They may degenerate into deep ulcers and be accompanied with acute glossitis, or swelling of the tongue, which may thus press against the teeth and its edges and be made to assume an indented or scalloped appearance. These phenomena disappear spontaneously in time, sometimes leaving deep furrows as the result of the glossitis which may be present.

The pustular form of the eruptions upon the skin may be degenerations of the papules, or the latter may disappear entirely to be succeeded by the pustules. Gradually the papules may become more pronounced and some of them may take on the pustular form, softening at the center and discharging a sanious fluid which is exceedingly infective. These may become aggravated and ulcerate and be very offensive. If, on the other hand, the disease does not assume a malignant type, they may dry up and disappear without ulceration. They may appear on the scalp or lower extremities as cone-like elevations, giving rise to large, irregularly shaped ulcers, secreting a bloody pus that dries up and forms dark brown or black crusts, or they may dry down and exfoliate the surface in the shape of scales, thus forming the squamous syphilides that may possibly be mistaken for psoriasis, or itch. It may thus be seen that the eruptions of secondary syphilis very widely differ in appearance, depending upon the constitutional condition of the patient and the type of the disease.

This pustular form does not offer the same phenomena in the oral cavity. On mucous membrane the mucous plaques may ulcerate and cause considerable pits, but they do not rise into cone-like elevations. As already asserted, there is no essential difference in the conditions, the mucous plaques or patches being the analogues of the papular eruptions upon the skin, and their ulceration answering to the pustules which appear on external cutaneous surfaces. When the one is present the other may be looked for in its proper place, the difference in manifestation being due to the modifications of the tissue.

During all this time the enlargement and induration of the lymph glands has been increasing and extending. They may proba-

bly be felt at this time along the posterior border of the sterno-cleido-mastoid muscle, the other cervical glandular regions, and those of the supraclavicular and epitrochlear localities. They vary in size from that of a pea to a pigeon's egg, are round, hard, and painless.

At the same time the constitutional disturbance begins to manifest itself in fever, the bodily temperature rising perhaps to 102° F., in pains of neuralgic or rheumatic character, and in severe headaches. There will be restlessness and sleeplessness, all the symptoms being worse at night, and exacerbated by fatigue or by exposure to extremes of temperature, by wet feet or any unusual exposure. The virus is infecting the deeper organs and interfering with functional activity.

It should always be borne in mind that the characteristic secretions of the syphilodermata are infectious in the highest degree. The blood at this time, as has already been intimated, may contain the virus to such an extent that it becomes noxious, and inoculation with it may produce the true phagedenic chancre. The saliva may be mixed with the discharges from mucous plaques and also be capable of communicating the disease. The whole system, in fact, is a loathsome, pestilential mass of corruption, revolting to the sufferer himself and abhorrent to others.

CHAPTER LVI.

TERTIARY AND HEREDITARY SYPHILIS.

Tertiary Syphilis is the final result of the specific infection. It is a breaking down of the tissues under the degenerative process, and is characterized by a worse series of syphilides, by necrosis of the hard, and ulceration, sloughing, and perhaps gangrene of the soft tissues. It is a process of general destruction, and some of its forms are repulsive in the extreme. The discharges are not, however, of such an infectious nature, and hence it is of less interest to dentists than the earlier forms of syphilis, but it should not be imagined that they are wholly without danger.

The period of incubation between the secondary or eruptive and the tertiary or constitutional stages is very uncertain. Some-

times the latter succeeds almost directly upon the heels of the former, and in other instances years may elapse after the disappearance of the syphilides before tertiary symptoms become manifest. Dr. G. W. Wende, of the University of Buffalo, reports one case in which only four weeks elapsed between the initial

FIG. 87.

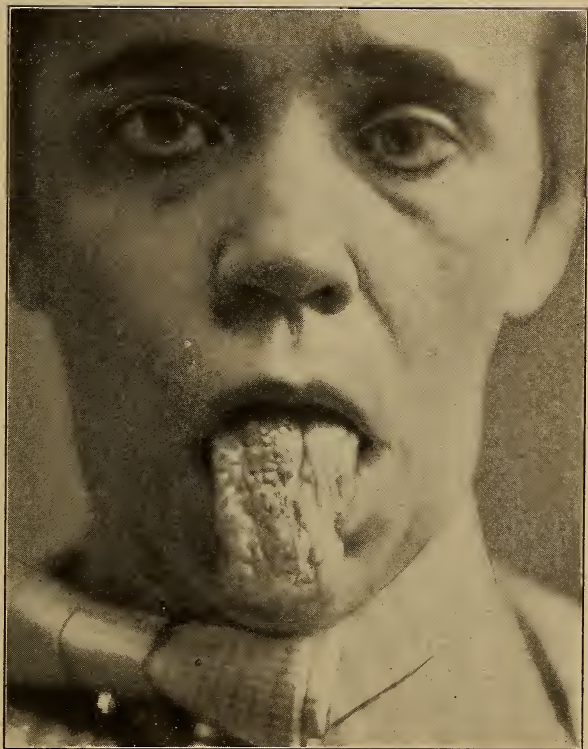
GUMMA UPON THE DORSUM OF THE TONGUE (GUMMATOUS INFILTRATION). (Wende.)

sore and the appearance of tertiary symptoms. In four months syphilitic necrosis had eaten away nearly all the bones of the face, destroyed the sight, and almost blotted out every feature. The author saw cases in the island of Cuba which assumed such a malignant form that there were no marked stages or periods,

the one succeeding the other so quickly. Indeed, hospital surgeons in Havana report that a typical form there is almost or quite incurable.

The syphilides of the tertiary stage commence with the appearance of tubercles or gumma, the former being in the skin or mucous

FIG. 88.



TOAD'S-BACK APPEARANCE IN SYPHILIS.

Gummatous Infiltrations (papulo-hypertrophies) producing the so-called toad's-back appearance. (Wende.)

membrane, while the latter are subcutaneous or submucoid. The advent of either in syphilitic patients is an indication that the disease has passed the eruptive or secondary period, and has reached the tertiary or constitutional stage. Tubercles are gran-

ular nodosities, usually very small and numerous, which may be felt in the epidermis. The gumma are thickened, swollen masses in the tissues beneath the surface, and are caused by infiltrations into the cellular structure. (See Figs. 87 and 88.) The latter usually appear as circumscribed, firm nodules, varying in size from that of a small cherry to that of an orange. At first the skin or mucous membrane is uncolored, but later it is apt to change to livid or purple, becoming thin at the apex and finally ulcerating. The gumma are not ordinarily numerous, seldom exceeding three or four in one subject. They usually leave a deep and abiding scar. When they appear in the roof of the mouth, or on the turbinated or palate bones, they may result in necrosis, with perforation and destruction of those bones.

The tubercular deposits are of special interest to the practitioner from the fact that they ordinarily prohibit surgical operations.

The condylomata, or venereal warts, are morbid growths, the result of syphilitic infection in its later stages, but as their observation will seldom come within the province of the dentist, they need not be considered here.

There may be leucoplakia of the dorsum of the tongue, which is characterized by the presence of pearly or bluish white patches upon its surface. This is a symptom, however, upon which too much dependence cannot be placed, as it may be only the effect of excessive pipe-smoking or the wearing of an artificial denture.

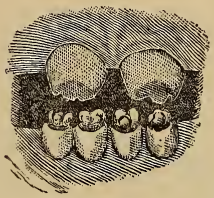
The chancroid, or soft chancre, is a sore which does not carry in its train any of the constitutional complications of the true Hunterian chancre. It is of a pustular nature, with a secretion that is peculiarly infectious, but which, unlike that of the true chancre, is auto-inoculable; that is, it infects the person in whom it exists at any new point with which it comes in contact, making another chancroidal sore. Hence chancroids are usually multiple, while the chancre is single. Chancroids very rarely appear elsewhere than upon the genitals, and produce no oral lesions whatever.

Hereditary or Congenital Syphilis.

That children may inherit this dread disease from either parent is a well-known fact. It appears under such conditions only in its tertiary form. There is no chancre, and there are none of the

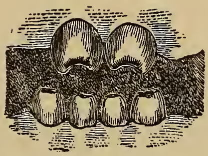
syphilides belonging to secondary syphilis, and hence there is no danger of the infection of others. The syphilitic father may transmit the disease without infecting the mother, and *vice versa.* If a mother acquires syphilis after her impregnation, she may transmit the disease to the fetus through the placental circulation. A healthy mother who gives birth to a child inheriting syphilis from the father may herself be infected, although the disease will be likely to assume a modified form. When there is impregnation, either of the parents being afflicted with recent syphilis, it is

FIG. 89.



HUTCHINSON TEETH WHEN RECENTLY ERUPTED.

FIG. 90.



HUTCHINSON TEETH LATER IN LIFE.

usually fatal to the fetus, either before or shortly after birth. The longer the time between the infection and the impregnation, the less will be the chance of transmittance, or the milder the form that the disease will take, especially when the parents have been under treatment.

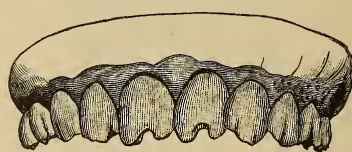
The usual indications of inherited or congenital syphilis are nasal catarrh (snuffles), erythematous eruptions, especially on the abdomen, mucous patches, cracks at the corners of the mouth which refuse to heal, poor development both physically and mentally, and bad nourishment. Sometimes the infant is born with these indications of its heritage, while in other instances none of them make their appearance for weeks, and the anxious parents are led to imagine that their offspring has escaped the taint, until a tell-tale eruption destroys their hopes.

Hutchinson believed that a peculiar formation of the teeth is indicative of congenital syphilis. This consists in a variation in the shape and formation of the central incisors, in which they are narrowed at the point and have a peculiarly crescentic incisive edge. (See Figs. 89 and 90.) That the so-called Hutchinsonian teeth are pathognomonic signs of syphilis is denied by very many, and they certainly are found where there are no other indications of this diathesis. But most syphilologists are agreed that when they are accompanied by interstitial keratitis and congenital deafness they may be considered as reliable indications.

Fig. 91.

Hutchinson Teeth in a Case in which there was a History of Syphilis.

Fig. 92.



Typical Hutchinson Teeth in which there was No Possibility of Inherited Taint.

That the so-called Hutchinsonian teeth are not an infallible sign of inherited syphilis appears to be conclusively demonstrated by Dr. E. L. Keyes, in the *Dental Cosmos,* Periscope, Vol. XXVII., page 570. A cast of the teeth of a patient then suffering from secondary syphilides, the primary sore having disappeared but a few weeks previously, shows the typical Hutchinsonian central incisors. Of course, inherited tertiary syphilis was in this instance impossible. (See Fig. 92.)

The prognosis in inherited syphilis is much more grave than in the acquired form. From one-third to one-half of all syphilitic children die before reaching adult life.

The first symptoms of inherited syphilis, the early syphilides, usually appear within the first three months. If an infant arrives at the age of six months without exhibiting any of the indications of syphilis, it may be safely assumed that it is healthy.

In all the later forms of syphilis almost the sole remedy upon which reliance is placed is iodide of potassium. Indeed, this is usually supposed to be a specific if administered in sufficient quantities. There is no limit to the size of the dose, save the ability of the patient to bear it. Sometimes it induces functional disturbances of so grave a character that its use must positively be intermitted or the amount given reduced, and in such instances it may be impossible to withstand the progress of the disease. But if the patient can bear enough of it, and its exhibition is persisted in long enough, a cure is usually certain.

CHAPTER LVII.

SYPHILIS OF THE MOUTH AND TONGUE: RECAPITULATION.

It was necessary to investigate the pathological changes that take place in syphilitic affections before its manifestations could be comprehended, or recognized when seen. If the nature of the syphilides is not learned, the dentist will not be prepared to understand their import when he meets them in practice. But it will be the oral phenomena that will chiefly concern him, and hence these should be awarded special attention, because of the possibilities of the transmission of the disease through his instrumentality.

The practitioner has already been cautioned against jumping to the conclusion that every mucous patch in the mouth, or every indurated sore, has a specific origin. Any excoriation of the mucous surface may be greatly aggravated by special irritants that are common in the mouth. The chewing and smoking of tobacco, the holding of pipes, cigars, and cigar-holders, the drinking of hot and iced fluids, may intensify a local irritation until it assumes a very suspicious aspect. In the same manner syphilitic sores of the mouth may take upon themselves an irritated character or appearance. But it should be borne in mind that these aggravations do not in essence differ from the same morbific changes occurring in other parts of the body.

Chancres occurring upon the tongue or in the oral cavity, although somewhat modified by their surroundings, present essentially the same characteristics as when they appear elsewhere. The same may be said of the roseola or maculæ, the papules, pustules and ulcers which have already been considered. Rough or carious teeth may aggravate them, and modify their appearance, but they will not destroy their leading characteristics. As a rule, the syphilitic lesions of the mouth are of a moist rather than a dry nature, and usually assume the form of mucous patches.

In the early stages of secondary syphilis, the eruption may appear in the mouth as well-defined areas of a dark red color, upon the soft palate, tongue, pillars of the fauces, and along the gingival labial borders. These may be of any size, from mere points to blotches covering the whole surface. But they will retain the symmetrical appearance of the cutaneous eruptions, and will usually be seen upon both sides of the median line. Like those of the surface, they may disappear after proper treatment, or they may form the basis for further degenerations. They usually become eroded to a greater or less extent, this probably being due to local irritation.

The papular syphilide of the cutaneous surface is represented in the mouth by mucous patches or moist papules. These may be single or multiple, and they are usually well defined, varying in size from a single point to that of a quarter dollar. They are at first red in color, but soon assume a whitish appearance, looking as if the mucous membrane had been cauterized with nitrate of silver. They may be raised above the general level, and are more or less painful. Two of them may perhaps be seen facing each other on membranes that are in contact, like the surfaces just back of the last molar tooth, or those of the cheek and beneath the tongue.

The ulcerative lesions are usually the further breaking down of the mucous patches or gumma, and their deep erosion until they form considerable caverns in the tissue, which are exquisitely painful. These may follow along the lines of the tongue, thus giving rise to deep fissures, or they may burrow into the crypts of the tonsils, or form circular pits on the posterior wall of the pharynx. Not only are fissures formed in the tongue, but they may make their appearance at the corners of the mouth or the centers of the lips.

An acute glossitis or inflammation of the tongue is not infre-

quently the result of syphilitic infection. There may be first an hypertrophy of the organ, with subsequent contraction, thus causing deep transverse or longitudinal furrows. There may be an indurative or hardening change in the muscular fibers, with a consequent partial loss of function, the speech becoming thickened and indistinct. Along the borders of the tongue dry or squamous lesions sometimes may be seen. They are not moistened by the usual secretions of the mouth, and in color are of a grayish or bluish white, sometimes having a glistening appearance. These patches are specially marked among users of tobacco, particularly those who are smokers, and there is a distinct variety that has been called "smoker's patches." They are not by any means confined to the borders of the tongue, or even to the tongue itself, but may appear anywhere in the oral cavity.

Gummata of the mouth may develop during the later stages of syphilis. There may be a compounding of these infiltrations in the sub-mucous tissue of the dorsum of the tongue, causing as many elevations and giving the characteristic "toad's back" appearance. (See Fig. 88.) Their initial appearance is as nodules beneath the mucous membrane, from the size of a pin's head to that of the end of the finger, usually single, but sometimes multiple. After a time they break down into ragged ulcers, and their degeneration is usually rapid. Perhaps one appears in or near the center of the vault, and when it breaks down a probe will detect necrosed bone, which is soon exfoliated, thus causing a perforation of the hard palate.

The syphilides of the mouth assume a variety of forms, and sometimes their diagnosis is impossible, except with the aid of the clinical history of the syphilitic infection. They may possibly be mistaken for other affections. The roseola may be confounded with a follicular stomatitis, and the ulcers with cancrum oris, or noma. Epitheliomata may be almost indistinguishable from some of the syphilitic lesions, though ordinarily they are much slower in their progress. Mercurialization may usually be distinguished from syphilitic disturbances by the fetor of the breath, and by the distinct metallic taste. But there may be innocent ulcerations upon the tongue or oral tissues, which the inexperienced syphilologist might mistake if he were to depend upon their appearance alone. The only safe course is to group the various

symptoms, examine for glandular indurations, and carefully and delicately inquire into the history of the case when suspicious appearances are observed in the mouth, all the time observing caution to guard against possible infection, for if there happens to be, as is frequently the case, any abraded or wounded point in the fingers, it is possible for syphilitic inoculation to take place from a secreting mouth-plaque.

CHAPTER LVIII.

PHYSICAL DIAGNOSIS.

The oral physician should be competent to make a proper examination of a patient, for the purpose of ascertaining the ability to withstand an operation, to take an anesthetic, or to determine the probability of constitutional complications. When the regular physician approaches the bedside of a sick person for the purpose of making a diagnosis he first takes the pulse, that he may determine the condition of the circulation. He next looks at the oral tissues, especially the tongue, because upon it he will find reflected any disturbance of the digestive tract. When he has learned to read these aright he has the key to the state of the two most important functions of the body, upon which, more than any others, health depends.

To be able correctly to interpret the utterances of the pulse, of the breathing, or the appearance of the oral tissues, it is essential that the physician know the language in which they speak. The technically uninstructed man may feel the pulse, but to him it tells nothing except that the heart is beating more or less regularly. The accomplished physical diagnostician with his eyes shut will at once pronounce whether the patient is strong or weak; is nervously excited or depressed; is in a fever or rigor; whether the disturbance is functional or organic; whether in the brain or extremities; whether there is or is not narcotic or other poisoning, with many other matters that it is essential to know.

The principal methods for determining the state of the internal viscera in physical diagnosis are auscultation and percussion.

Auscultation is the determination of the condition by listening to

the sounds which are produced in normal or diseased functions. It is called immediate when the ear is applied directly to the part, and mediate when a stethoscope or other instrument for conducting the sound is employed.

Percussion is the striking lightly upon any part of the body, especially the thorax or abdomen, with the view of determining diseased conditions by the resonance or lack of resonance of the sound. It is called immediate when made direct with the fingers, and mediate when a pleximeter or some instrument is used to increase the sound. Usually immediate percussion is employed by laying the first two fingers of the left hand upon the part, and striking them with the ends of the first two fingers of the right hand.

Perhaps the dentist may not need to become an expert, but he should at least know the most important expressions of the heart, the lungs, and the digestive tract, as expressed in the pulse, the breathing, and the oral tissues.

The Pulse.

The Pulse is the change in the shape and size of an artery due to a temporary increase in the tension of its walls following a contraction of the heart. The muscular constriction of that organ forces the blood out of its ventricles and drives it through the arteries. The coats of these vessels are more or less elastic, according to their condition, and yield to the impulse, and if the finger is placed over an artery which lies near the surface a wave of the sanguinary fluid may be felt with each contraction as it is propelled from the heart forward. Of course, the nearer the central organ the more plainly perceptible is the impulse, while its character will vary with the resilience of the arterial coats.

To be able to recognize the pulse in disease, it is necessary to know what it is in health. It varies in different individuals, and changes with their condition. It is not the same during growth as in maturity, and every physical state has its appropriate expression. There is a difference of five to six beats per minute between the pulses of men and women of relatively the same general physical condition otherwise. A difference of from five to ten beats is made by change of posture from the recumbent to the erect. By violent running, or any excessive exercise, the rate may be doubled. It is higher in infant than in adult life, and it decreases yet more in old age.

The pulse may be felt at any accessible artery, the larger and nearer the heart the more distinctly. It is usually examined at the point of nearest exposure of the radial artery, in the wrist, but dentists should be able to read the pulsation of the facial artery, where it crosses the inferior maxilla, because it is more convenient, especially in the administration of anesthetics. It may also be taken from the carotid artery in the neck, or the temporal beneath the ear.

If the pulse is taken at the radial artery the tips of the first two fingers should be used, with the second finger nearest the heart. The strength is determined by pressing with the second finger until the pulse cannot be felt with the first, and taking note of the amount of force required to compress the artery. The number of pulsations are computed by counting. The pulse should never be taken when the patient is in any state of excitement, because its true reading cannot be obtained at that time. When first placed in the chair, or if a view of the instruments is obtained, the pulse may be raised several beats, and will be changed in its character. The best time will be after the patient has entered the office and sat for a few moments, until all nervous excitement shall have passed away. Then, in the midst of conversation and without intermitting it, the hand may be taken and the pulse examined. Of course, no alarming display of instruments or apparatus will be permitted.

At birth the average pulsations are from a hundred and twenty to one hundred and forty per minute. The rate gradually diminishes until at seven or eight years it is about ninety. In adult life it is from sixty-five to seventy-five, while in old age it sinks to sixty. Some people have normally a very slow pulse, while others have one that is rapid; hence it is essential to have some knowledge of what is the normal rate. But an experienced physician will tell by its reading whether the slow or fast pulse is the result of some disturbing influence, or whether it is normal. By the use of the sphygmograph, an instrument devised for that purpose, he may obtain a permanent tracing of the pulse and all the variations in the blood pressure, recorded through the elasticity of the arterial coats. (See Figs. 93 and 94.)

In disease the pulse presents certain modifications that depend upon the kind of disturbance. In the principal changes certain definitions are given which are definite in their meaning. For

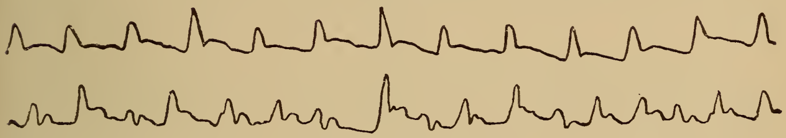
instance, there is a marked difference between a rapid, a quick, and a frequent pulse, and each conveys its own tale. The principal modifications are as follows:

A frequent pulse means one that is diminished in force, but increased in frequency. It is the result of and indicates debility. Thus before death it may be so frequent as almost to be beyond counting, and so weak as to be almost indistinguishable. The muscle of the heart is losing its contractile force.

FIG. 93.

SPHYGMOGRAPHIC TRACINGS OF THE PULSE FROM THE RADIAL ARTERY IN A HEALTHY MAN, AGED TWENTY-FIVE. (Chapman.)

FIG. 94.



SPHYGMOGRAPHIC TRACING OF THE PULSE, SHOWING LOW TENSION, WITH IRREGULARITY, IN A CASE OF MITRAL REGURGITATION. (Musser.)

A quick pulse is abrupt, jerking, and may be moderate or frequent in its rate of pulsation. It indicates some irritable state of the heart, which may be of only a temporary nature.

The slow pulse (unnaturally so) occurs in narcotic poisoning and in apoplexy. It will be found in compressions of the brain from accident, and in unconsciousness from opium or liquor. This characteristic enables the physician to determine malingering, and the simulation of unconsciousness. Another method to detect counterfeiting is to press the end of the thumb with considerable force on the supra-orbital foramen for one or two minutes, gradually increasing it. No conscious person can long withstand this.

The hard pulse seems to indent the finger, and is what the name indicates. It shows great excitement of the circulation, with high tension and rigidity.

The soft pulse is the direct opposite of this, and indicates lassitude. It is easily compressed, though it may not be readily extinguished.

The febrile pulse is an increase in the rate of pulsation, and usually of force also. It is found in active fevers and inflammations of an acute character.

The feeble pulse is nearly synonymous with the soft pulse, but is more easily extinguished. It is indicative of great debility and exhaustion.

The thready pulse is one that gives beneath the finger the sensation of a vibrating thread. It is allied to the *wiry pulse*, which is an exaggerated condition. Both are sometimes present in very great debility.

The irritable pulse is one that is both frequent and hard. It will be found when a debilitated person is subjected to some kind of excitement.

The intermittent pulse is one that now and then loses a beat. It is indicative of either functional or organic disease of the heart. It should not be confounded with the weakened pulsations of exhaustion.

The irregular pulse is one that varies in both frequency and force. It may be very slight, or it may be extreme. It is generally found in heart disease, but it may be the result of the use of tobacco or strong coffee or tea. The inordinate use of stimulants may also produce an irregular pulse.

In reading the pulse; for instance to determine the ability of a person to withstand the effects of an anesthetic, the practitioner must first be sure that the patient is not laboring under the excitement of fear or apprehension. The mind should be diverted until the pulse is normal, when the hand may be quietly taken. The first thing will be to determine the frequency, to learn if there is any functional excitement. If so, due allowance must be made. Then its regularity should be observed, to discover if there is any organic trouble. After this its force may be observed, to ascertain if the heart is strong enough to withstand the shock that must be produced by the anesthetic agent or the contemplated operation; and finally the condition of the pulse should be carefully noted, to know if there is any functional irritation which would be indicated by the "quick," "febrile" or "irritable" pulse.

The practitioner should lose no good opportunity for the study of the pulse, both in health and disease. He will find that his comprehension of it and his ability to detect variations will greatly increase with practice. He must learn to read it as he would Greek, by first conquering its alphabet, and then slowly and patiently acquiring the combinations. He will discover that he can acquire real skill and facility in reading the one about as easily as the other.

It should be comprehended that all these modifications are not produced simply through changes in the force exerted by the heart in its pulsations. The readings depend upon the condition of the coats of the arteries quite as much. Their resilience, or elasticity, is governed by the vaso-motor nerves, and hence any nervous shock or neural depression will be readily manifested in the arterial walls, in the manner indicated in the section on Inflammation. Thus the "hard" pulse and the "soft" pulse will mainly depend upon the tension of the muscular arterial coats, while the "slow" pulse and the "frequent" pulse will be the result of the condition of the heart, or the rate of its pulsations.

A "feeble" pulse indicates that the force of the heart-beats is lessened, and at the same time the tension and resiliency of the arteries themselves are reduced. The "soft" pulse, on the contrary, simply implies a change in the coats of the vessels, without any special heart complications.

The "hard," or "wiry," or "thready" pulse shows an undue tension of the arterial coats, and this will be induced through some nervous impression acting through the vaso-motor system.

It may thus be seen that the pulse gives a very clear indication of the state of the nervous system, and reveals any neural shock or depression; and that at the same time it is indicative of the state of the blood column and of the functional activity or languor of the heart.

CHAPTER LIX.

PHYSICAL DIAGNOSIS (Continued).

The Respiration.

This is the inspiration and expiration of air through the lungs. By means of the first the blood is oxygenated, while by the

last it is relieved of the effete products of vital action. This must continue as long as life lasts. The various sounds made in breathing, as well as those of the heart, may be determined by the use of the stethoscope, or by placing the ear to the chest, not more than one thickness of cloth intervening.

The breathing is termed either abdominal or thoracic. That is, the muscles chiefly used may be the diaphragm, or the costal and superior thoracic. The breathing in man is mainly abdominal, while in woman it is thoracic. In forced and labored respiration yet other muscles may be brought into action, as the trapezius, serratus magnus, and the sterno-cleido-mastoid.

In health, the respiration is from thirteen to twenty-five per minute. In the dyspnea of pneumonia it may rise to from thirty to fifty per minute.

The normal respiration should be without effort, deep, and unhurried. There should be no unusual noises or râles, and the natural murmurs of the passage of air through the bronchial tubes should be present when the ear is placed to the chest.

The amount of air respired by each individual is about five hundred cubic centimeters, and, of course, the same amount is exhaled. But it should not be understood that all the air is expired at any one time. After the fullest expiration there will still be left in the lungs fifteen to eighteen hundred cubic centimeters. In forced expiration, or exhaustion, most of this air may be forced out.

The purification of the blood is through the process of respiration. Oxygen is taken in, and carbon dioxid, water, and various organic matter are exhaled. A great deal of effete matter is eliminated from the pulmonary surfaces. In the administration of anesthetics they are usually taken into the lungs by inhaling their vapor, and thence pass directly into the blood; in their elimination it is chiefly the lungs which throw them off. They circulate with the blood until they again reach the pulmonary surfaces, when they are given up. Hence, in the recovery from the anesthetic state, it is of the first importance that the breathing be maintained evenly and regularly, as otherwise the poison remains in the system.

In diseased conditions the respiration may be either faster or slower than the normal. When it is very much accelerated it will

probably be superficial, shallow, and gasping. This will be the case when it is above thirty-five, in pneumonia, pleurisy, obstructions in the trachea, or any kind of dyspnea.

It will be retarded and will be deep in narcotic poisoning and in cerebral compressions, falling as low as twelve to the minute.

When the lung is filling up, becoming consolidated, it will be interrupted, broken, and irregular.

Bronchial breathing will be marked by blowing, as through a tube, and it will have a high pitch. This will be the case in advanced phthisis, in exudations, hemorrhages of the lungs, etc.

The normal sounds that are heard when the air rushes through the various passages are called "respiratory murmurs." In health these should be smooth, regular, easy, and without interruptions. All the involuntary muscles of respiration should work without effort, and the expansion and contraction of the thorax should be uniform and regularly periodical. The practitioner should carefully observe these particulars before attempting a closer examination, and without allowing the attention of the patient to be called to it, that he may learn what is the usual rate, for the frequency and effort may be increased by the nervous irritation attending auscultation.

In diseased conditions the respiratory murmurs may be materially changed. The breathing may be labored and difficult, through partial closure of the respiratory passages by inflammatory action, through stoppage by fluid exudations, or by nervous constrictions.

The bubbling sound that is produced will be either coarse or fine. The coarser it is the higher up it will be, and the weaker will be the patient. It means the presence of water and moisture in excess in the air passages. These air tubes must always be properly lubricated, but when through some pathological condition moisture accumulates in inordinate quantities, it impedes or even wholly stops the passage of the air. In the latter case the patient may absolutely be drowned in his own effusions.

Gurgling, like water boiling, may be heard in pulmonary cavities at times, and indicates an advanced state of phthisis.

Splashing sounds upon succussion, or shaking or striking the chest, in the pleural organ indicate hydro- or pyo-pneumothorax—water or pus, with air, in the pleural cavity.

Loud whistling or wheezing that may be heard at a distance in the larynx or trachea indicates stenosis, or constriction, and is heard in croup.

Low-pitched snoring in the larger bronchi means spasms, or narrowing of the bronchi, as in asthma.

A crackling sound located in the air vessels of the lungs shows a sticking of their walls, and is heard in pneumonia.

Creaking, grazing sounds are heard in pleurisy, and indicate exudations upon the surfaces of the pleura.

Metallic, tinkling sounds in pleural or pulmonary cavities mean pneumothorax, or the escape of air into some cavity.

The abnormal sounds produced when the air breaks through impediments or passes over obstructions in the lungs, bronchi or trachea, are called *râles* (French *râler,* to rattle), and are said to be either moist or dry.

Dry râles will usually be induced by a condition of the air passages in which they are not lubricated with the normal mucous secretion, or when it is inspissated or thickened; hence they are usually of a crackling or whistling character.

Moist râles are produced when the obstruction is fluid, and are apt to be of a bubbling nature. Peculiar conditions may, however, modify either of these, and special pulmonary diseases have their own specific râles.

Cavernous râles are observed when there is a cavity filled with pus.

Crepitant râles are the crackling sounds symptomatic of the first stage of pneumonia.

Mucous râles are the bubbling sounds produced by the passage of air through bronchial mucus.

Sibilant râles are those that have a sharp, hissing sound, as when air passes through a contracted moist passage, or through foaming fluids.

Sonorous râles are the stertorous, snoring sounds, as if the air were interrupted by some vibrating substance.

Friction râles are the creaking sounds heard when, without the lubricating fluid that is natural to them, two surfaces rub upon each other.

Vesicular râles are the fine crepitant sounds heard in the vesicles of the lungs in the early stages of inflammation.

Subcrepitant, or tracheal, râles are heard when mucus accumulates in the larger bronchi, or the trachea, and they form what is called the "death rattle." It is usually a premonitory symptom of dissolution.

There are other murmurs heard in auscultation than those produced by the air in inspiration and expiration. They are caused by the movements of the blood current in the vessels, and by the friction produced by gliding surfaces in the organs of respiration and circulation. Sometimes the French term "bruit," having the same signification, is applied to them.

The arterial murmur is the sound made by the arterial current, and it may be normal or disturbed.

The cardiac murmur is the union of the systolic (contracting) and diastolic (dilating) sounds produced by the muscular actions of the heart and the passage of the blood through its auricles, ventricles, and valves.

Hemic murmurs are the sounds due to changes in the quality and amount of the blood itself, and not to modifications in the vessels or valves.

The venous murmurs are the so-called "bruit de diable" of the French, produced in the common jugular in anemia, lead-poisoning, etc.

Artificial Respiration.

The dentist will not infrequently be called upon to use artificial respiration, and a few plain, uncomplicated directions are necessary. Many persons each year are lost whose lives might readily enough be saved if this subject was better understood. No one should be pronounced dead as long as there is the very slightest flutter of the heart, or when there is any vital warmth present. People have been restored after hours of unremitting efforts, unrewarded by even a gasp until near the end. Artificial respiration has held death at bay for days before any voluntary efforts could be induced.

In cases of cessation of breathing not an instant should be lost in getting the patient into a prone or recumbent position, if he is not already so placed. All clothing should be loosened and the tongue seized with a pair of forceps, or a tenaculum, and forcibly drawn forward, at the same time raising the head a little to insure the opening of the glottis. In the absence of any such instrument any other suitable object may be thrust in the mouth and the base of the tongue pressed down and forward with it. Something

should then be placed under the patient's shoulders to raise the chest. The coat of the operator is excellent, if nothing else is at hand.

The most simple and easily comprehensible method of producing artificial respiration is that called "Sylvester's," and either this or some other that is equally effective should be at once employed. The operator will place himself at the head of the unconscious person and seize the wrists. Then by a sweeping motion the arms should be extended, and at the same time horizontally carried to their fullest extent above the head. After an instant's interval they should be carried back by reversing the motion until they rest across the body just below the diaphragm, when firm pressure upward and against the body should be exerted. These motions should be continued about fifteen times per minute for an indefinite time, at the same time keeping up the bodily heat by the use of hot-water bottles, hot flannels, and chafing of the extremities.

In cases of drowning, or the presence of fluid in the air passages, the body should first be held with the head down and the epiglottis be kept open to expel the water. Violent rolling upon a barrel or like object should never be practiced, as the shock may extinguish the lingering spark of life. Water will always run down hill if its course is unimpeded. It is well in such instances occasionally to interrupt the artificial respiration momentarily, turn the body on the side and depress the head, to allow the escape of any fluid that may have been expelled from the air passages.

When there is sinking after the giving of an anesthetic, or in cocain or opium poisoning, artificial respiration may be necessary; but if breathing is once established the patient should be exercised as violently as practicable to assist the circulation and to aid in the elimination of the drug. A hypodermic injection of brandy may be administered, or one of ammonia. Strong coffee is an excellent antidote, as is any stimulant. Cocain poisoning will be manifested by symptoms very like those due to opium. People do not die of cocain poisoning except after the lapse of some time, as in poisoning from opium, and the narcotic effects are plainly visible before death ensues. The instances in which it is related that death occurred within a few moments after the injection of a

cocain solution were doubtless errors of diagnosis. The patient probably died of something else than narcotic poisoning.

CHAPTER LX.

THE ORAL TISSUES IN DIAGNOSIS.

All gastric disturbances are reflected in the tissues of the mouth. The tongue especially is very expressive, and the oral physician or dentist should learn to read its indications as he would an open book.

In health, the tongue is of a delicate whitish pink color, smooth and moist. Any departure from this appearance, either in the tongue or the other oral tissues, means a pathological state that demands the attention of a doctor. In another chapter, local inflammations with their symptoms have been described, and it remains but to give the appearance in general functional disturbances.

The tongue is at times covered with a coating called "fur." This always indicates defective circulation of some kind. Fur consists of the unremoved epithelia of the mucous membrane, of the thickened, inspissated mucus, of the *débris* of food, or of some deposit. In pathological conditions the furring of the tongue is by regular gradations, commencing at the base and spreading toward the tip. In clearing up this is reversed, the clean spots first appearing at the end and sides, and spreading toward the base, so that by watching the progression or retrogression of this process a fair knowledge of the progress of the disease may be obtained.

Generally speaking, a dull whitish color of the tongue indicates a hyperacid condition; while red, with fur, points to an alkaline or inflammatory state.

A delicate whitish tint of the tongue within two hours after eating means that digestion is not completed. This tint should not be confounded with disease indications. If the tint remains for more than four hours it means arrested digestion.

White, with a thin coating, means acidity. A yellowish white, acidity with biliary irritation. A very white and thick coating

("flannel mouth") means intense venous congestion, as in cerebro-spinal meningitis.

Red, a delicate pinkish tinge, indicates that digestion is completed.

Red of a deeper hue means arterial congestion.

Red, a very deep and dark tinge, means the last condition very much exaggerated.

Red, bright in color and raw or glazed, indicates paralysis of the sympathetic—approaching fatal exhaustion.

Brown, or brownish red, with a thick dry coating, means prostration; arterial congestion; carbonic acid poisoning—a sign of danger.

Black, or blackish, not deep, means blood poisoning—pyemia; sepsis.

Blue, or a bluish tinge, indicates lack of oxygen; cyanosis.

Humidity of the tongue means atony (lack of tone), with anemia.

Dryness means nervous irritation; debility.

Flabbiness, fullness, tremulousness, indicate great debility.

Imperfect muscular movements, difficult articulation, means cerebro-spinal irritation; drunkenness.

There are exceptional conditions that are but temporary in character and not indicative of a real pathological degeneration. These must not be lost sight of, but must first be eliminated as causes in making a diagnosis. The following are instances:

The tongue may be furred in health, as in excessive smoking.

A dry tongue may be due to fever or to loss of sleep, or to excessive fatigue.

In old age the tongue loses its diagnostic value to a great extent.

In scarlet fever the desquamation may cause what is known as the "strawberry tongue." It is generally accompanied with desquamation of the kidneys, etc.

Depressing nervous impressions may cause a tremulousness and dryness that is but temporary, as in fright and great anxiety.

Pleasurable sensations, the sight of food, etc., may induce a temporary humidity. "The mouth waters."

It should be understood that it is not the tongue alone of the oral tissues that is indicative of the bodily state. Others may be equally expressive, and the judicious diagnostician will take them all into account in making up the sum of the objective symptoms.

A red line, or red blotches, along the gums at a little distance from the margin is a diagnostic sign of pericemental or periosteal irritation.

A still deeper red color, with excessive flow of saliva, is found in ptyalism, or mercurialization.

A blue line along the gums at the margin is indicative of lead poisoning.

Great sponginess, sloughing of the gums, with fetor, indicate scurvy.

Dark red gums, puffiness, everted edges, with oozing of pus, are found in pyorrheal conditions.

Purple gums, with a purulent discharge at more than one point, are indicative of caries or necrosis of bone.

Gums hot and swollen, very tense, with a determination toward one point, mean suppuration, alveolar abscess, phlegmon.

Gums inflamed and soft, with fluctuation, indicate the pressure of pus, which should be evacuated.

Swollen gums, fetid discharge, mucous patches, shallow ulcers under the tongue, eruptions about the mouth, skin, and scalp, gums everted, with fetid matter about the necks of the teeth, the tongue perhaps swollen and flabby, with the edges scalloped by the pressure of the teeth, may be found in syphilitic conditions.

It should be comprehended that not all these symptoms or appearances will be observed in one mouth, but any one of them should stimulate the dentist to further examination and inquiry.

The indications of imminent danger as presented by the tongue are a tremulous action, dryness, blueness, very red, shining, or glazed aspect, heavy furring, dark or black hue—the so-called "black tongue."

In considering the tongue and the oral tissues as diagnostic organs, the indications are not to be taken alone. The appearance should always be studied in connection with other symptoms, which may be the dominant ones, and may reverse the usual significations. The oral tissues are to be considered as auxiliary, and not in every case pathognomonic. The diagnosis is to be reached by grouping all together, and reading one sign by the aid of the others.

CHAPTER LXI.

WOUNDS AND INJURIES.

A wound is a solution of continuity in the soft parts, suddenly produced. It is a rupture of the tissues by some form of mechanical violence, and may be produced by a direct or an indirect application of force.

A wound may be a complete separation, with exposure of the tissues to external influences, or it may be a mere contusion, without any breaking of the integument.

Wounds have their own train of symptoms, which are usually quite pronounced, so that, except in certain instances of deep-seated injuries, their diagnosis is comparatively easy.

Wounds are distinguished by pain, hemorrhage, loss of function, shock, and, in injuries of the head, concussion.

The pain is characteristic, and is usually proportional to the amount of the injury. When the tissues are crushed and there is deep contusion, the pain is sometimes very severe.

The hemorrhage varies greatly with the vascularity of the tissue affected. All wounds must have some hemorrhage, for all soft tissues are supplied with blood. Even in case of a wheal, which is merely a stripe or a ridge upon the skin, such as follows the cut of a whip, there is usually more or less capillary bleeding.

Loss of function differs with the location. It may be merely local or it may be general, varying with the extent of the injury and with the tissue involved. A single small muscle may be cut, as for instance the extensor of one of the digits, in which case the function of but one finger would be interfered with; or there may be such laceration of the muscles of the hand as to inhibit the action of all the fingers.

Wounds are succeeded by traumatic "shock," which will be proportioned to the resistive force of the body at the time, the amount of injury, the location of the lesion, etc. The physical condition of the patient may be such as to make this very profound, or there may be a high condition of tonicity that will minimize it. The lesion may be in such vital organs that the constitutional disturbance will be great, or while considerable in extent the wound may be in tissues that

react but feebly. The age of the patient makes a material difference in the amount of the consequent shock, and sex is an important factor, women suffering from it much less than men.

Wounds are incised, lacerated, contused, punctured, perforating, gunshot, or poisoned.

An incised wound is one made as with a sharp instrument. Its diagnosis is not always as easy as might be imagined, for a blow with a bludgeon may cause an incised wound if it be delivered over a bone with a sharp edge, in which instances the incision will be from beneath, and not from the surface; or the impact of a blunt instrument may be at such an angle as to produce a sharp rupture of the tissues.

A lacerated wound is one in which the tissues are pulled apart. They are torn and ragged, and it is usually the result of an injury from compound causes, such as being caught in complicated machinery.

A contused wound is one which is made with a blunt weapon. There is usually crushing of the tissues, without breaking of the skin. In such instances the connective tissue, with its inclosed vessels, always suffers. If but a few vessels are injured it is commonly called a bruise. The hemorrhage consequent upon a contused wound is slight, and is usually limited to mere ecchymosis, or infiltration of blood into the tissues. The ordinary "black eye" is an instance of this. The blood extravasated into the cellular tissue assumes the dark venous hue, changes to a purplish black, then to a brownish green, finally assumes a yellow tint, and is absorbed.

A punctured wound is one that is made into a cavity of the body. The gravity of a punctured wound depends upon the cavity that may be reached. Punctured wounds of the abdominal, the thoracic, or the cranial cavities are usually of a serious nature, owing to the danger of infection.

A perforating wound goes entirely through an organ or a tissue. The terms perforating and punctured are occasionally confused, some pathologists defining as punctured wounds those made by a pointed instrument, and perforating wounds those which reach to and open a cavity of the body.

Gunshot wounds are those made by the discharge of fire-arms. Works on surgery usually consider these as a distinct class,

because of the special complications in which they are apt to be involved. Not infrequently in gunshot wounds foreign substances are carried in, such as portions of the clothing, *débris* of the explosion, etc. Thus the danger of infection is greatly increased, and the irritation produced is much more violent. The impact of bullets, from their great velocity, increases the probability of shock, and at the same time too often disengages splinters of bone, which bring on new complications. The rotation of the rifled bullet adds to the amount of destruction of tissue, so that the track left by its passage, while very difficult to follow with a probe immediately after the injury, is peculiarly liable to be made manifest subsequently, through the breaking down of the tissue.

A poisoned wound is one that is infected with some mineral, vegetable, or animal poison. The most common of these are the bites of poisonous reptiles or insects, the stings of bees, wasps, etc., and the effects produced by the poison ivy, oak, and other toxic vegetables, as well as by bites of men and animals and infections by dirty tools.

Wounds may be of a septic or aseptic character. In the former they have become infected with septic organisms, and there will be breaking down of tissue with suppuration, or the formation of pus. The septic bacteria are the greatest enemies the surgeon has to encounter in the treatment of wounds, and hence his chief efforts are directed toward the establishment of an aseptic, or sterile condition.

Wounds are healed by primary union, or, as it is often called, First Intention, by granulation or Second Intention, and by Third Intention. They are united by means of the fibrinous plastic exudate which is the result of the inflammatory process, and which earlier or later in the progress of healing agglutinates or unites the severed walls.

Primary union or First Intention is the healing without infection. There is no retrograde metamorphosis, or breaking down of tissue. There are no acute symptoms of any kind, and no granulation occurs.

Granulation, or Second Intention, is the healing of a wound by the regular progressive additions of papillary or grain-like growths. Capillary loops form at the bottom of the cavity of the wound, and through them new tissue is developed. Upon the summit of

these, new capillary loops appear and new granulative tissue is formed, which follows the type of that from which it originated or to which it is to be joined, and this process is continued by "healing from the bottom," until the waste tissue is restored. (See Fig. 12.)

Third Intention is the direct union of two surfaces on which granulation has already taken place. In fact, it does not in essential character differ from second intention, the granular or capillary loops being formed in the same manner, but there is less of cicatricial or scar tissue as the result.

It should be borne in mind that this system of nomenclature is rather arbitrary, and in part founded upon hypotheses which are not fully accepted by modern pathologists. All healing in one sense is by a kind of granulation, but as this phenomenon presents certain distinct phases, and as the old system of nomenclature will doubtless be insisted on for some time to come, it has been retained with this explanation.

When granulation becomes too exuberant it may continue above the surface, and is then commonly denoted "proud flesh." Usually, when the capillary loops reach the level of the surface, the fibrous exudate contracts and cuts off the blood supply, and the process is stopped. There is a proliferation of the epithelial cells, or a growth of the investing tissue over it, and it is thus covered with the dermal appendage, and the process completed. But, as has been stated, this may not take place, and in that case the result will be a hyperplasia, or excessive formation. For further study of the healing process the student is referred to the chapters on inflammation.

CHAPTER LXII.

TREATMENT OF WOUNDS.

The healing of a wound is induced and incited by cleanliness and an aseptic condition. In treatment the first step, in the case of an open wound, is to remove any foreign substances. Especially in incised, lacerated, and gunshot wounds should careful examination and, if necessary, exploration be made, to determine if any extraneous matter has been carried in by the instrument of injury.

If this is suspected, the wound must be carefully laid open to its extremest point, and thorough exploration made. There can be no healing so long as any particle of irritating foreign matter remains.

In the case of a lacerated wound, the tissues should be carefully examined to determine the probability of the maintenance of the vascular supply in them. If the bloodvessels are so thoroughly destroyed that circulation will be completely cut off, such injured tissue must be removed, to obviate the dangers of gangrene. They cannot recover unless they are supplied with pabulum, and this is carried by the arteries. Hence, if there is no chance for the restoration of circulation in the part, amputation or excision is imperative, and should not be delayed.

The destruction of an artery or vein does not by any means imply that circulation is entirely prevented, for it may be carried on through the collateral supply. It is only when all, or nearly all, the communicating tissue is so injured that its vessels can no longer convey a supply of blood that its removal is necessarily demanded. Amputation of a part has sometimes been resorted to when the circulation might have been maintained, and when the vigor of the patient might have promised continued functional activity.

The wound should be irrigated, and thoroughly washed out with a disinfecting and sterilizing fluid. It is sometimes necessary to use a great deal of judgment in selecting this. If the injury is very recent it is not well to use a mercuric chloride solution, because this may induce mercurial poisoning. Nor should carbolic acid or iodine be employed, as they may bring about carbolic or iodine poisoning. Preparations of hydronaphthol, formalin, or boric acid are preferable. If, however, there is an infected condition and pus is present, the stronger germicides, like mercuric chloride 1 part to from 2000 to 4000 parts of water, may be employed.

It is not sufficient if only the interior of a wound is cleansed. The tissue about it should be carefully washed with an antiseptic fluid, and all foreign matters removed. If the edges are surrounded by hair, this must be clipped or shaved off, that it may not harbor any impurities, and everything that might cause irritation must be heedfully eliminated.

No operations about a wound are permissible without the most stringent antiseptic precautions. All the sponges and cloths used must be sterilized. The hands of the surgeon must be thoroughly washed with aseptic soap, all matter under the nails being removed, and finally they must be drenched with an antiseptic mixture, or washed with ground mustard used in place of soap.

A broad and shallow vessel partly filled with a solution of carbolic acid, hydronaphthol, formalin, or some other good antiseptic, should be provided for all instruments used, and these must frequently be dropped into it. Especially if any instrument or sponge should happen to come in contact with any unsterilized body, as by an accidental dropping upon the floor, must it be given a bath in the sterilizing tray.

If the hemorrhage from a wound is light in color, or if it issues by distinct spurts, it is arterial. If dark in color and steady in its flow it is venous; if merely oozing it is capillary. Either may be controlled by means of the hemostatic forceps, and by ligatures. Enough of the former instruments should be kept in the sterilizing solution for any emergency. With one of these the mouth of a bleeding artery or vein is seized, the handles are locked, and it is allowed to remain in position until the close of the operation. If the bleeding has not then been stopped by the contraction of the muscular coats, a ligature may be passed about the vessel and the ends allowed to protrude from the wound.

When the bleeding is capillary, it may be necessary to pass a ligature around a portion of the tissue for the purpose of arresting it. When it is venous, it is sometimes sufficient to seize the mouths of the vessels with one pair of artery forceps, draw them out sufficiently to allow of grasping them with a second pair, and then to close them by torsion or twisting.

For controlling the hemorrhage caused by the severing of important arteries, the only effective means is the ligature, the application of which sometimes demands expert knowledge and judgment. Great injury may be done by unskillful ligation. In the larger vessels, the arteries, veins, and nerves may be within the same sheath, which is but an infolding of the fascia; and there may be more than one vein. Before ligating, the sheath should be opened and the vessel to be tied dissected out. The ligature should be passed about it, and fastened with a square knot to prevent

slipping. The knot should be drawn firmly, but not too tight, lest the outer coat of the vessel be cut, and sloughing and secondary hemorrhage be the result. An artery should not be drawn out of its sheath any farther than is necessary to allow of tying, because in so doing its future nutrition may be interfered with, through separation of or injury to the vaso-motor nerves.

Immediate or mediate compression may be used for stopping the flow of blood temporarily when it is excessive.

Immediate compression is accomplished by packing the wound with lint, and then applying a compress or bandage.

Mediate compression is when pressure is made upon the artery between the wound and the heart. Any firm substance is placed over the artery, and then a bandage or tourniquet is twisted very firmly about the part until the bleeding is controlled.

The control of bleeding by acupuncture is sometimes necessary in aged persons, the muscular coats of whose arteries are too weak to withstand the ligature. This consists in transfixing the tissues with an acupuncture needle, and then winding about it a ligature in such a manner as to produce local compression.

Aneurisms may be formed through injuries to arteries, when some of their coats are divided and there is dilatation of those which remain unpunctured. In their earlier stages aneurisms may be diagnosed by the distinct pulsations within them, but later this may be masked by the thick felt of blood coagulum which forms within. A tumor in the immediate neighborhood of an artery should be opened with extreme caution, lest it prove of an aneurismal character.

The ligating of an artery, when skillfully done, does not deprive the tissues dependent upon it of their vascular supply, as sufficient collateral circulation is soon established. This takes place through an enlargement of the communicating and anastomosing smaller arteries given off above and below the wound, until they are sufficient to convey the volume of blood originally carried by the divided vessel.

A wound having been cleansed and irrigated, and the hemorrhage having been completely controlled, the next step is to close it. If the gaping is considerable, it may be necessary to sew it up. This is done with sutures of catgut if it is deep, or with silk if more shallow. The stitches are made with suture needles of differing

shapes, which may be passed by means of needle forceps. All ligatures or sutures must be thoroughly sterilized before using. The depth of the stitches must be proportioned to the depth of the wound. If this is considerable, it may be advisable first to insert a few catgut sutures to hold in place the deeper tissues. The final closing ones are always superficial, and they should be near enough together to prevent any gaping of the edges. The closing stitches should be carefully made, so that there will be no drawing of the integument, the borders of the wound being left in smooth coaptation. They are to be removed as soon as there is sufficient union to prevent the separation of the edges. This will be within a very few days, if all goes well. Sometimes it is necessary to use deep retentive sutures to prevent undue tension upon the closing stitches. They have their insertion at some distance from the margin of the wound, and each end is attached to a button, so that they will not be likely to cut through the tissues.

If the wound has become infected with septic organisms, or if there is good reason to suspect that it will be impossible to keep it aseptic, it may be necessary to insert a drainage tube before completely closing it. This may be of sterilized rubber, or of decalcified bone; or it may be only some strands of silk or gauze, carried to the deep portion of the wound and allowed to come to the surface; and its size should be proportioned to the amount of probable discharge. The drainage tube offers a ready means of escape for pus or sanious matter, secretions of glands, or the products of inflammation. If the tube penetrates to a cavity of the body, some effective means, like a ligature or the insertion of a safety pin, must be employed to prevent its being drawn into the cavity. To retain it and keep it from slipping out, it may be held by the external dressings, by adhesive strips, or other convenient means. The drainage tube is to be left in place as long as there is a necessity for its presence. Sometimes it is of great convenience in irrigating or washing out the wound.

The final dressing of a wound should be with antiseptics. After terminal washing and cleansing of the exterior with an antiseptic fluid the surface is usually dusted with aristol, acetanilid, or iodoform. A piece of antiseptic gauze is then superimposed, and upon this sterilized cotton batting, in quantity sufficient to make a thick pad. The wounded organ may then be bandaged,

and placed in a sling or support if required. The dressings may be removed when necessary, but should not be disturbed by meddlesome interference.

Poisoned wounds that are of a serious character, such as the bites of venomous serpents, should be immediately ligated to prevent the spread of the poison in the blood, and then be thoroughly cauterized. The latter may be effected by the actual cautery or by cauterizing agents like silver nitrate or chromic acid. An effectual though not agreeable way is to burn gunpowder upon the wounded surface. This may be practicable in case of accidents when no other cauterizing agent is at hand.

The after treatment of wounds consists in the exercise of the most watchful care to avoid septic infection, or to combat it when present. All dressings must be kept clean and in place, and changed if necessary to accomplish this. But meddlesome interference must be avoided, and no dressing should be removed unless there is good cause for it. When the organizable lymph has been effused it must be protected and kept aseptic. Every sanitary precaution should be observed, and the patient sustained with a nourishing diet. A wounded limb must be kept quiet and muscular action prevented, except so far as motion of joints, etc., is required to prevent ankylosis.

CHAPTER LXIII.

EXCESSIVE BLEEDING.

There is nothing in dental practice that is more alarming, especially to the young practitioner, than to have follow an operation an unusual flow of blood which cannot readily be checked. Too many lose their presence of mind at such times, become confused and distracted, exhibit this in their manner, and thereby alarm both patient and attending friends. A physician is perhaps called, who assumes direction of affairs, and the dentist is relegated to a subordinate position. As a consequence he is humiliated and loses the confidence of all who are witnesses. Exaggerated accounts of the matter are circulated from mouth to mouth, and his professional reputation may thus be irretrievably injured in the commu-

nity. All this may at any time be the consequence of lack of knowledge, or a deficiency in professional self-confidence. In any sudden emergency the most important requisite on the part of the doctor is self-possession, and the entire command of his own powers.

The first thing to consider in cases of hemorrhage is whether it is arterial, venous, or capillary. If the former, the blood will be a bright red, and will issue from the wound in jets, synchronous with the heart-beats. If it is venous, the blood will be darker in color and will well up continuously. If it is capillary, there will be a slow oozing from the edges, which will appear again as it is wiped away. This, while the least alarming in appearance, is really the most threatening, because it may be the result of a hemorrhagic diathesis.

Arterial bleeding may always be checked by ligation of the artery. Usually, however, unless the vessel is an important one, it will be sufficient to wipe away the blood with a sponge until the mouth of the severed vessel is found, when it should be grasped with a pair of artery forceps, which are at once locked upon it. In their absence the mouth of the artery or vein, with a little of the surrounding tissue, may be seized with any suitable pliers, and the whole twisted and pinched until the coats of the vessel contract sufficiently to stop the bleeding. Sometimes a waxed silk ligature passed around it and closely tied is preferable.

If the bleeding is from the socket of an extracted tooth a pledget of cotton, or lint, or sponge that has been dipped in tannic acid, or, in its absence, in powdered alum, or red pepper, or in a solution of iodine, turpentine, capsicum, or even dilute sulphuric acid, should be closely packed at the bottom, and on that a cork, cut to a conical form that shall fit the socket, should be placed in such a manner as to project sufficiently for the occluding tooth to shut firmly upon it. A two-tailed bandage may now be used firmly to press up the lower jaw and hold the cork in position. This should be left for some hours at least, when the bandage and cork may be carefully removed, leaving the cotton until it loosens itself.

If the bleeding is distinctly venous the same methods may be employed, but the emergency will not probably be as great. Arterial bleeding will be certain to receive attention, but the smaller veins may continue open, and there may be a steady loss of blood for

hours, which will gradually weaken the patient. If this is the case, an examination should be made to determine whether the bleeding is from the small veins or is distinctly capillary. If the former the points of its issue may be readily determined, but if it is the latter there will be a slow oozing from the tissues without any distinct point of exit.

If it is capillary hemorrhage, the condition will demand the greatest care and cause the most anxiety. Strips of cotton wet with a tannic acid solution, or a ten per cent. solution of antipyrine, or with one of the other hemostatics named, should be adjusted over the wound, if on the surface, and bandaged to place if possible. Monsell's solution of perchloride of iron should not be used in the mouth, nor should any active cauterants be employed. Tannic acid, in doses of one to four grains, may be administered in water every two hours in extreme cases. Or, of the aqueous extract of erigeron, from five to ten grains may be administered every two hours. Or from fifteen to thirty drops of tinct. of ergot may be given every hour until the bleeding ceases. The feet should also be placed in hot water for half an hour. Veratrum viride, as an arterial sedative, in doses of two to five drops every two hours, will frequently prove useful.

In the so-called hemorrhagic diathesis the tendency toward capillary bleeding is due either to some abnormal condition, the result of a distinct dyscrasia, or to a lack of tone in the system. It seems to be idiosyncratic with some. When either of these is the cause it may demand more than a general knowledge of the subject, and the family physician should be called to learn whether there exists any special cachectic condition. If this is the case it will, of course, be turned over to him. Anemia, purpura, scrofula, typhoid, and other diatheses tend to induce excessive bleeding, and in their presence great care should be used. If there is any special idiosyncrasy the patient will probably know of it, and should warn the dentist before any operation is commenced.

CHAPTER LXIV.

FRACTURES AND THEIR TREATMENT.

THE consideration of fractures should properly be taken up in connection with surgical procedures. But, as cases of injury to the jaw and head may at any time fall into the hands of the dental practitioner, this work would be incomplete if their pathology was not in an epitomized manner given some attention. More than this is not attempted.

A fracture is a solution or rupture of continuity in bone or cartilage. What wounds are to soft tissues, such are fractures to the framework of the body. They form one-seventh of all the injuries to which human beings are liable. They are ten times as frequent as dislocations. They are of all degrees of severity, from the mere indentation or irregular depression of a flat bone to the complete comminution of long bones. The character of the fracture will depend upon the force which produced it and the shape of the bone itself. Thus, in irregular bones the fracture is usually a compression, while in long bones it is likely to be a complete separation, with more or less displacement of the fragments.

Fractures may be produced by external violence or by internal muscular action. Probably a much greater proportion of them are caused by the latter than would be readily imagined. In falling from a considerable height the muscles may be so spasmodically contracted as to break the bones of their attachment before the individual strikes the ground.

The strength of bones, and therefore their ability to withstand injuries, depends upon their texture. Compact tissue is stronger than that which is cancellous, and the bones of different individuals greatly vary. So also does the strength of a bone alter with the physical condition, certain diatheses predisposing to weakness, until perhaps in some extreme instances they yield to comparatively slight muscular exertion, and break almost spontaneously. The shape of bones has also much to do with their strength, the long and flat being more liable to fracture than the irregular.

The bones of males are stronger than those of females, but

they are more exposed to accident. Age has much to do with the resisting power of the different parts of the skeleton, those of older people being more brittle. Weak points, or curves, largely deter-

Fig. 95.

Bony Ankylosis of the Elbow Joint.

mine the course of fractures, especially when they are the result of muscular action.

Fractures of the bones are said to be either Simple, Compound, or Complicated.

A simple fracture is one in which the skin or mucous membrane is not ruptured, and there is no serious injury to the investing tissue.

A compound fracture is one in which there is a communication through the skin, or exposure of the bone to the air, with the possibility of infection.

A complicated fracture is one in which other tissues are involved in the injury.

Fractures are also classed by surgeons as Complete and Incomplete.

A complete fracture is one in which there is a separation of the body of the bone into two or more fragments. Complete fractures may be divided as follows:

A Transverse Fracture is one that is at nearly right angles to the axis of the bone.

An Oblique Fracture is one that is at an angle of ten or more degrees.

A Longitudinal Fracture is one that is at an angle of more than seventy degrees.

An Epiphyseal Fracture is a fracture of the cartilage which unites the epiphysis, or extremity, to the shaft of a bone. Of course it can only occur in young persons.

A Multiple Fracture is one in which the bone is separated into a number of fragments.

An Impacted Fracture is when one fragment penetrates another, thus preventing their free movement.

A Comminuted Fracture is one in which the bone is shattered, or separated into fine particles.

An incomplete fracture is when there is not an entire separation of the body of the bone, but either it stops short of that or consists in the breaking off of a portion. Incomplete fractures may be classified as follows:

A Fracture of the Apophysis is the separation of that process from the shaft.

A Detached Fracture is the separation of a fragment, as by a cutting instrument.

Fracture of the Malleolus is a separation of the hammer-shaped head of a bone, the body or shaft remaining intact.

A Green-stick Fracture is what its name indicates: the splintering of a bone without its entire separation. This is necessarily mainly confined to long bones, and to young persons.

A Fissured Fracture is the opening of a crack in one plate of a bone, as in certain fractures of the crania.

A Depressed Fracture is when a dent is made in the table of a bone, a part being thus displaced without entire separation.

The diagnosis of fracture, although usually easy, may be exceedingly difficult. The symptoms presented are both objective and subjective. They may be arranged under the following heads:

History of the predisposing or immediate cause. This should always be carefully inquired into, especially if the force seems inadequate to the production of the injury.

Localized pain and tenderness. This may be determined by pressure and digital manipulation.

Crepitus, or Crepitation. This is the grating of one fractured end upon another, and is determined by careful movements of the parts. In impacted fractures this means of diagnosis is eliminated, and hence it may be difficult to arrive at a conclusion.

Abnormal mobility. It is sometimes almost impossible to determine this in the neighborhood of joints, unless crepitus is present.

Consequent deformity. This may be partially or completely masked by the swelling consequent upon the injury.

Comparison of two sides. This is very important in determining the deformity, but a possible asymmetry may lead one astray, unless caution is used.

When the deformity is reduced it will not remain so, but the parts will separate and reproduce it. This will distinguish a certain class of luxations from fractures.

Anesthesia is sometimes necessary in making a diagnosis, owing to the resistance of muscular action.

Treatment of Fractures.

Bones very readily unite when their injuries are properly treated. Reduction is the first thing to be accomplished. If there are no complications, and if the fractured ends are firmly

held in apposition, there will be a deposit of plastic lymph—in this instance usually called provisional callus—about the injured extremities. This assumes a cartilaginous form, and in due time ossifies and firmly unites the fragments, the process demanding from four to eight weeks. There will necessarily be some temporary enlargement and deformity, which will greatly depend upon the amount of displacement. In time, as the newly formed tissue becomes fully organized, the projecting portions will be resorbed, and the irregular surfaces thus made more symmetrical.

Before the final reduction any muscular injury must be attended to, and if there are complications, such as involvement of a joint or injury to a contained organ, or comminution of the bone, these must be looked after.

The greatest obstacle to reduction and retention will be the muscular contraction consequent upon the injury. This must be controlled by traction and counter-traction. A steadily applied, moderate force must be brought to bear upon the muscles until they gradually yield. Violence will only increase the contraction, but a gentle, persistent force, like that of a weight, will after a time tire the muscles out, when they will readily give way.

Oblique fractures usually need only extension for their reduction. Transverse fractures with displacement require also manipulation.

When reduction is accomplished, the parts are usually held in place by splints or bandages. Absolute immobility is not required, as slight motion is beneficial, owing to the fact that it is a stimulus to functional activity, but this must not be sufficient to interfere with the deposition and organization of the provisional callus.

In the treatment of compound fractures, the wound must be considered as an open one, and the instructions given in Chapter LXII., Treatment of Wounds, should be kept in mind. Thorough asepsis must be secured if possible. An anesthetic may be administered and the injury thoroughly explored for the removal of all comminuted fragments, blood-clots, and foreign matter. A drainage tube may be inserted if desirable, and the wound left open at its center.

Delayed union, or non-union, may exist when the plastic exudate is not promptly thrown out, or being deposited is not organized. Perhaps the circulation or nutrition is impaired. This condition

should be attentively looked after. The ends of the bone may be rubbed together if necessary, to stimulate functional activity.

Delayed union may result in the formation of a "false joint," or a fibrous union. In such instances it will be necessary to break this up, and perhaps to bore the ends of the bone, or scrape them, to induce a new osseous formation.

Fig. 96.

Fibrous Ankylosis of a Joint.

Non-union may be the result of a neglect properly to reduce the fracture. The ends of the bone may become rounded off by resorption and the medulla be closed. The remedy in such instances is to open the seat of the fracture, saw off the ends of the bone, and depend upon a new formation after reduction.

In fractures of the long bones, shortening is likely to be the result of muscular contraction and the overlapping of the ends of the fragments, unless extension is used.

CHAPTER LXV.

SPECIAL CASES OF FRACTURE.

Fractures of the nasal bones may be determined by the deformity, by the infiltration or emphysema of the investing tissues, by crepitus, and through obstruction of the nasal passages by blood-clots. They are not dangerous unless the injury is at the base, when the cribriform plate of the ethmoid may be injured, and a shock thus given to the brain. The adjustment must usually be by means of directors or needles thrust up the nostril, and the parts are held in place by adhesive strips.

Fig. 97.

A Simple but Effectual Method of Wiring the Teeth Together for the Purpose of Reducing a Fracture.

Fractures of the superior maxilla and of the alveolar process may be met with. If they are incomplete and there is no special deformity they have little significance. The nasal and alveolar processes are frequently broken. The former may be a complication of injuries to the nasal bones. The latter may be broken in careless extraction of the teeth. It very readily unites, and usually requires little attention unless a small fragment is displaced, in which case it should be removed.

Fractures of the body of the superior maxilla may result from great violence. There is no bone which so readily unites, and all that is usually necessary is to reduce the fracture as completely as

possible, and retain the parts in apposition by bandages and adhesive strips. When the injury is considerable, the adjustment may sometimes be made by getting the teeth in alignment, and retaining them by ligatures, gold bands, or even an artificial palatal plate.

The antrum may be involved in fractures of the superior maxilla, and this may introduce a complication that may embarrass the treatment. In such a case the directions given in Chapter XXXV., on Diseases of the Maxillary Sinus, should be observed.

The hemorrhage in fractures of the maxilla is not usually serious, and it will not be difficult to control.

Fractures of the inferior maxilla are three times as common as those of the superior. This is because of their increased liability to accident through their greater exposure. The fractures are most often those of the body, although the ramus may be the seat of the injury.

The diagnosis is easy, except when the injury is to the coronoid process or the ramus. The symptoms are pain, deformity, mobility, and crepitus. The teeth form a most important auxiliary in both diagnosis and treatment. Observation of the position of the jaws and the occlusion of the teeth, if the latter are present, will ordinarily be sufficient to determine the amount of injury and the best method of reduction.

The treatment of all such cases is best accomplished by the dentist, because he is familiar with the normal condition of the organs involved, and he has the mechanical skill to construct the appliance which will best reduce the displacement and retain the fragments in proper apposition. Too often the proper function of the teeth is lost through lack of the knowledge how to secure their proper alignment, or so to retain the fragments that normal occlusion will be secured when healing is complete.

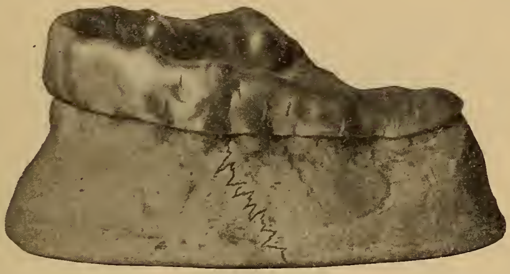
Various forms of splints have been devised by ingenious dentists for the treatment of fractures of the inferior maxilla. Some have held the fragments in apposition with the upper jaw by banding the opposite or occluding teeth on each side of the line of fracture, and then holding them together firmly by means of a connecting screw or clamp.

Various devices for wiring the teeth together have been proposed. The general surgeon has in the past mainly depended upon this method of retention.

Skull caps, with fixed or elastic bandages passing around the lower jaw, have been employed.

Where there are enough of teeth in each jaw to serve the purpose, an excellent method for reducing and holding in place the fragments is simply to place around convenient teeth silver wires, and then twist those opposite each other together until the teeth are in correct apposition and held firmly in occlusion. The twisted ends may be covered with small rubber tubing and bent down closely, to prevent their lacerating the buccal tissues. The jaws are thus held together until union has taken place. If no teeth have been lost, so that feeding can be through the

FIG. 98.



SWAGED ALUMINUM SPLINT TO BE CEMENTED IN POSITION.

Its borders between the teeth can be pinched together so as to hold the fractured parts firmly in position. The swage is made from a plaster cast that has been sawed apart at the points of fracture and afterward properly adjusted.

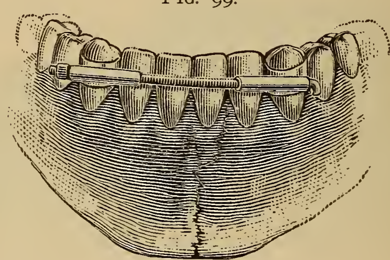
vacancies, it is always possible to carry sufficient food into the mouth through the space posterior to the molars, liquids being mainly used. (See Fig. 97.)

One of the most effectual methods is the employment of some form of the interdental splint. An impression of the fractured jaw is taken in some plastic material, without any attempt at replacement of the fragments. A cast of this is made in plaster of Paris, which gives a counterpart of the deformed jaw. Another impression and cast of the occluding jaw and teeth is secured. A fine saw is run through the cast of the broken jaw at the point or points of injury, and the pieces placed in proper apposition with the cast of the superior teeth, when they are fastened by running plaster of Paris about them. They are placed in an articulator and a wax model of a splint is made for the lower jaw which will

properly occlude with the teeth of the upper jaw, so that mastication may be possible during the process of healing.

The wax model is reproduced in vulcanite, and when the fragments of the broken jaw are adjusted to it they may be retained in various ways. In the case of one such fracture of the jaw of a noted pugilist treated by the author, which had remained unreduced for some weeks, nothing more was needed than the insertion of four gold screws through the outer plate of the splint, which obtained their hold in the V-shaped space between two teeth that were close together. Although this case demanded a subsequent operation from the outside for the removal of comminuted fragments, it was not found necessary to remove the splint until healing was complete.

FIG. 99.



METHOD OF HOLDING IN POSITION THE PARTS OF A JAW FRACTURED AT THE SYMPHYSIS. (Angle.)

In another case, one of fracture of both the upper and lower jaws in a boy of fourteen, the splint consisted of a gutta-percha impression of each jaw, trimmed to proper shape. After their preparation, and immediately before their insertion, the occluding surfaces were warmed so that they would adhere together when reduction was accomplished, an elliptical opening between the anterior teeth being made for the purpose of feeding. The adjusting of the parts and the insertion of the splints, with the necessary bandaging, was accomplished under chloroform. The whole work, including the taking of the impressions, the fashioning of the splints, and the reduction, occupied less than an hour, although three very competent physicians and an accomplished surgeon had vainly kept the boy under an anesthetic for more than four hours previously. Their failure was solely due to their inability to construct a splint that would hold the parts in apposition when they had the different

fractures reduced, and not of course to any lack of surgical skill or knowledge.

The judicious and ingenious dentist will readily devise an appliance that will be sufficient to retain the fragments in any form of injuries to the jaws. No two cases present precisely identical conditions, or require the same treatment, and he will vary his appurtenance so that it will meet the required ends.

It is no part of the scope of this work to give instructions for the mechanical manufacture of splints, interdental or otherwise.

CHAPTER LXVI.

DISLOCATIONS AND SPRAINS.

A Dislocation is the complete or partial separation of the articular surface of one bone from that of another, or the displacement of an organ from its natural position.

That which will most frequently be met in the practice of the dentist is the luxation of the lower jaw. This may occur in extraction or in other operations, and not infrequently it may be spontaneous and happen in gaping or yawning. Some people are liable to it on slight provocation, the condyle easily slipping out of the glenoid fossa.

Joints or articulations are movable and immovable or fixed.

If movable, they are complex in their structure and are united by flexible ligaments.

If slightly movable, they are usually connected with fibro-cartilage, which is tough, elastic, and pliant.

If immovable, they are connected by mere membranous sutural ligaments.

Sometimes the union of fibro-cartilage is so firm that only a fracture can cause displacement.

The ends of articulated bones, if the joint is a movable one, are enlarged and made up of compact tissue, the lamellæ differing from those of the other parts, being without Haversian canals. The nutrition thus being less complete, they are more apt to die.

Articular cartilage covers the ends of bones, and, as has been said, fibro-cartilage separates certain of the joints, such as the

vertebræ. A man is half an inch taller in the morning than at night, because during the day, when he is in an upright position, the interarticular fibro-cartilage becomes compressed.

A ligament is a band of compact membranous tissue connecting the articular ends of bones, and sometimes enveloping them in a capsule. It is not the office of the ligament to hold the bones together; that is the function of the muscles, the ligament merely limiting and restraining the motion, preventing it from going too far.

The synovial membrane is a short membranous tube inclosing the joint, attached at the edges of the cartilage, and secreting the synovia, or synovial fluid, for the lubrication of the joint.

When there are many muscles and great flexibility is demanded, as in the wrist, there is very seldom a dislocation.

Dislocations are traumatic, pathological, or congenital.

Traumatic dislocations are the result of external violence or of muscular action. They are by far the most frequent of any.

Pathological dislocations are the result of the destruction of a part of the articulation by disease.

Congenital dislocations are those in which some essential part of the joint has never developed, and hence they are irreducible.

Dislocations, like fractures, may be simple, or compound, or complicated.

A simple dislocation is one in which there is displacement, without injury to any tissue.

A compound dislocation is one in which there is a wound that exposes some part of the articulation to the air.

A complicated dislocation is one in which important nerves, blood-vessels, or other tissues are involved in the injury. Complicated dislocations are fortunately infrequent.

The symptoms of dislocation are much the same as those of fracture. They are as follows:

Deformity. This will be evident from the unnatural position of the bone, and from the tumor which will be the result.

Pain. This may be quite severe, and it will be located at the position of the joint. It will probably be of a dull, sickening character, and it is worse than that of a fracture.

Rigidity. This will arise from the fixation of the parts, the voluntary movements being entirely absent or very much limited.

New position of the bone. This may often be traced through

the tissues by digital, or even, in some cases, ocular examination. The axis of the bone is altered and all its relations are modified. Usually there is lengthening or shortening, as in fractures.

Dislocations are differentiated from fractures by the immobility of the former, the absence of crepitus, and by the general appearance, the character of the pain, etc.

In dislocations there is usually complete fixation with no power of voluntary movement. In fractures, on the contrary, there is apt to be abnormal movement which is not under voluntary muscular control.

Dislocations are treated first by reduction. This is best secured by manipulation, whenever that is possible.

If the ligaments are badly torn and the luxation is thus complicated, manipulation may cause exceeding pain, and an anesthetic may be necessary.

Sometimes in old dislocations there have been exudation and partial organization of the product, with perhaps more or less of bony ankylosis (see Fig. 95); or, more probably, fibrous ankylosis may have been formed, so that it is impossible to obtain reduction without surgical help (see Fig. 96). In these cases it may be necessary to open the joint and break up the union. This must, of course, be done under the strictest antiseptic precautions.

Dislocation of the inferior maxilla may be unilateral, involving but one side, or what is more frequent, bilateral, with forward displacement. It consists in a slipping forward of the condyle from the glenoid fossa, over the eminentia articularis. It occurs only when the mouth is widely opened. The external pterygoid muscle becomes violently flexed, and draws the condyle forward upon the surface of the bone. The temporal muscle becomes rigid, and helps to hold the condyle in its false position. The interarticular cartilage is carried forward with the condyle, but the capsular ligament is not usually torn. (See Fig. 100.)

The symptoms of luxation of the inferior maxilla are a rigidity of the jaw, with inability to move it or to close the mouth. There is a marked projection of the chin, and the condyle may be felt forward of its normal position. If it is unilateral there is a deviation of the jaw toward the uninjured side.

The reduction of the dislocation is effected by supporting the symphysis, and at the same time depressing the angles of the jaw, the object being to carry the condyle downward and backward until it will slip over the articular eminence. The operator should stand in front of the patient, and, the thumbs being protected by wrapping around them a handkerchief, the jaw is firmly grasped with both hands, the protected thumbs being placed far back over the molar teeth. Then, by pressing down with the thumbs and supporting the symphysis with the ends of the fingers, the jaw may usually be carried to place, the condyle slipping into the glenoid fossa with a distinct snap, and the jaw closing with considerable violence.

Fig. 100.

Dislocation of the Lower Jaw, showing the Anatomical Relation of the Parts. (After Sir A. Cooper.)

Sometimes it may be necessary to use a stout piece of wood between the back teeth as a lever to carry the condyle down and back, the angle being supported with the hand. This method will be found especially useful in unilateral luxations. Some kind of a pad should always be placed between the teeth of the two jaws, to prevent their being broken with the violence of the closure when the reduction is made.

Dislocation of the lower jaw backward sometimes occurs, but only as the result of great violence, and is necessarily accompanied by fracture of the borders of the fossa. The dislocation in this case becomes of less importance than the other injury, and its reduction is subordinate to the other treatment.

A Sprain is a self-reduced dislocation, with consequent soreness from the violent strain upon the muscles and tendons, and with possible laceration of the ligaments or attachments. It is characterized by severe pain, much increased by movement, with rapid swelling and heat in the joint. Sprains are usually treated by either hot fomentations or cold applications, whichever seems indicated. The former will be likely to bring about resolution, while the latter will be demanded when there is a great deal of heat and an intense hyperemia. If the swelling is very great, through excessive effusion, it is well to bandage with cotton, and to secure immobility by means of a plaster of Paris bandage, after the swelling shall have subsided.

CHAPTER LXVII.

SHOCK—COLLAPSE.

Shock is the depression that is caused by severe injuries, surgical operations, or great mental disturbance. It is the result of a profound impression made on the cerebro-spinal axis, either directly through some afferent nerve, or through the circulation. It may be reflex and slight, like the temporary faintness which soon passes away, or so severe as to induce a vital depression that is almost instantaneously fatal. It has already been shown that it is not the bullet in the heart that kills, but the impression upon the whole nervous system which is its consequence. In such an instance the shock is the direct result of the impact. But no less fatal may be the indirect effects of a mental impression. It is related that the janitor of a medical school had made himself so obnoxious to the students that even his life had been threatened. As the result of a conspiracy among them he was captured one night, conveyed to a sepulchrally draped room, shown a block and ax, and informed that he was to be executed. Amid the solemn and impressive surroundings he was seized by the masked men, his neck bared and placed upon the block, when the executioner struck with a towel wet in ice-water. The victim was taken up dead. The shock was as complete as though the actual ax had been used.

There is a wide difference in the susceptibility of different persons to shock. Some are of an emotional nature, and comparatively slight mental impressions of a depressing kind produce profound effects. Others are more stolid and apathetic, and lose their nervous equilibrium less readily. It is well known that an unimportant mishap will, in some instances, produce fatal effects, while in others the system will successfully withstand the gravest injuries. The immunity of drunken men to the results of accident is proverbial. Their intoxication so exalts or stupefies the nervous system as to fortify it against or exempt it from shock, the usual result of injury.

The shock that is caused by mere mental impression is more frequent and often more profound than that produced by actual violence. Especially is this the case with nervously susceptible people. The mere sight of a dentist's instruments too ostentatiously paraded may induce a depression and shock to a nervous female that will be absolutely more injurious than the contemplated operation. Any incivility of manner or unnecessary roughness of method on the part of the operator may, to a timid child, be worse than the real pain, because it can induce a more profound shock. Infants suffer less from shock than adults, other things being proportionally equal, as the element of apprehension, or mental impression, is eliminated. In the light of these truths it is easy to comprehend why the gentle, suave, sympathetic dentist is able to perform with comparative ease to the patient operations that another finds absolutely impracticable.

It is because of the limiting of the primary shock that operations under the influence of an anesthetic are possible and safe, that otherwise would be fatal. The beneficence of these agents and the glory of the discovery of anesthesia is not confined to the immunity from pain which they give, but they have saved lives almost innumerable through their making feasible operations that before were impracticable.

The usefulness of prophylactic remedies, to be employed before dental or oral operations, lies in their ability to prevent shock to the nervous system, either by stimulating it so that it can successfully withstand disagreeable impressions, or so stupefying it as to make it insensible to them. In either case the primary shock is correspondingly lessened or inhibited. The entire confidence of a

patient once secured, especially that of a child, the nervous system will without injury undergo, or even be insensible to, pain that under other circumstances would be unbearable, because the deadly influence of shock is avoided. It may readily be conceived, then, that the subject is of paramount importance to the operative dentist, and that it is his bounden duty to study it with care. In this connection, the remarks upon nervous influence in the chapter on Hypersensitive Dentine will be found useful.

The distinction between shock and collapse is one not easily made plain, nor is it necessary here to draw a fine discriminating line. It is sufficient if we consider shock as the result of either mental or physical violence, while collapse is the final consequence of continued exhaustion. Thus the impact of a bullet may induce shock, but the slow bleeding that may succeed it will finally end in collapse.

Shock may not only be the result of different kinds of injury, physical or mental, but it may assume different forms. It is impossible to draw a clear line of demarkation that shall place in separate categories all those which are possible, but for convenience they may be classed as torpid, excitable, and delayed.

In torpid, or apathetic, shock the symptoms may be almost entirely referred to vaso-motor paralysis. The circulation is materially modified. There will be a pallor of the skin and of the mucous membrane, with coldness, especially of the extremities, and the patient may be covered with a cold perspiration. The expression of the face is changed or lost, the pupil of the eye is dilated and does not respond readily to light. There is irregularity of the action of the heart, with a weak, thready, and perhaps almost imperceptible pulse. The respiration becomes slower and more superficial. There may be partial or complete insensibility, mental inactivity, and loss of control of the voluntary muscles. There will be depressed bodily temperature, perhaps to be followed by a corresponding rise, and in some instances nausea, and possibly vomiting.

In excitable, or erethistic, shock the patient is restless, irritable, easily disturbed, perhaps uncontrollable. There is found a disordered pulse, with irregular breathing and dilated pupils. Notwithstanding the actually depressed condition, there will be the appearance of unnatural activity. The sufferer may per-

haps exhibit an impatience with and opposition to the institution of the proper remedial measures, or the continuance of any necessary operation. To the operative dentist, these symptoms are often premonitory of a more profound impression, and are not to be disregarded. Upon their appearance he should use redoubled care to avoid further nervous injury, and should promptly administer an anodyne.

Delayed shock is the condition in which the symptoms are only manifested some hours after the injury or nervous impression has been received. They do not materially differ in reality, and may be of either the torpid or the excitable character. They may be the result of a slow and concealed hemorrhage. This type is often observed after dental operations that were not of a serious nature, but which were considerably prolonged. The patient probably has not incurred any material harm, aside from the bodily depression that ensues, and the character of the symptoms will be rather of the excitable than the apathetic kind.

The physical condition will not be materially different, no matter what the cause of the shock or the nature of the early symptoms. If it is serious the torpid state will gradually deepen into coma, and the excitement will as progressively subside into entire insensibility. The bodily heat may steadily become less, the breathing more superficial, the pulse weaker and more rapid, until death closes the scene. Sometimes this will be an unexpected end, the injury or nervous impression seeming totally inadequate to produce it. As has already been affirmed, the result often depends more upon the physical condition of the patient, and the bodily ability to resist or sustain the deadly depressing influence, than upon the nature or extent of the injury itself.

CHAPTER LXVIII.

TREATMENT OF SHOCK.

The treatment of shock consists in the institution of measures to bring about a reaction. But these must be cautiously approached if the depression is very profound, or if it arises from or is accompanied by any great loss of blood. There is danger that the

reaction may be too great and exhaustive, or that recovery from the syncope or coma may be followed by a fatal return of the hemorrhage. Hence, in case of accident the precise condition should be determined before any extreme measures are attempted.

Sometimes great difficulties are encountered in using the usual remedies. This is especially true in that common form of nervous shock called syncope, or fainting. Consciousness being lost, perhaps the patient cannot be made to swallow, and if fluids are forced into the mouth they will not be taken down the esophagus, but may go into the trachea and cause suffocation. If the shock is so profound that the circulation is arrested, there will be little use in attempting hypodermic medication; and if the breathing is suspended, inhalations of volatile stimulants will be impossible. There will, of course, be cerebral anemia, and this should be at once combated by laying the patient in a recumbent position, with the head as low as the rest of the body, or even lower. All obstruction to a free circulation, like clothing that is too tight or a violently flexed position of any limb, should be remedied. The lower extremities may be raised, and pressure used to press the blood out of them toward the head. If there is blueness of the lips, it may indicate that the head is too low, or that there is some obstruction about the neck.

As soon as possible, warm stimulating drinks should be given, such as dilute whiskey or brandy. Volatile stimulants may be applied to the nostrils, such as ammonia, nitrite of amyl, etc., but care should be observed to avoid their being so unduly strong, or so persistently applied, as to cause suffocation. If the body is cold, external heat should be applied by wrapping the patient in hot blankets, or by laying bottles filled with water, not too hot, in the axillæ and about the body. Chafing the extremities should not be resorted to until consciousness has returned, lest it draw away the blood from the head, where it is most wanted.

Artificial respiration should be used if the breathing is suspended and is not readily resumed. This may be continued as long as is necessary, but it should not be violent. Every precaution should be taken to avoid the deepening of the shock. It is needless to say that in the unconsciousness resulting from drowning, the violent rolling of the body upon a barrel or other object is the surest way to extinguish whatever of vitality may remain.

If the stomach will not retain remedies, or if the patient cannot swallow, stimulating drinks may be administered as enemas, and alcoholic dilutions, or strong coffee, with carbonate of ammonia, etc., will be almost as useful as when given by the mouth.

Hypodermic medication is very useful when the circulation has been maintained or restored. The activity of the heart may be stimulated by strychnine and digitalis. The respiration may be strengthened by atropine. These remedies should be given in large doses. Park recommends that in serious emergencies there may be given in one hypodermic injection one c.c. of tincture of digitalis, with one-twentieth of a grain of strychnine and one-hundredth of a grain of nitro-glycerine. This to be repeated as often as necessary, or digitalis alone may be administered at frequent intervals.

In case the shock takes the form of extreme nervous excitement, anodynes should be given. Opium, in the form of morphine sulphate, is the most effective, and one-eighth to one-quarter of a grain may be administered hypodermically. The patient should be kept as quiet as possible until reaction is complete.

When the shock is due to great loss of blood, as from tooth extraction, a saline solution, consisting of sterilized water 1000 parts, ammonium carbonate 1 part, and common salt 6 parts, may be slowly injected, the nearer to the place of injury the better.

The hypodermic syringe should always be kept in order, and be thoroughly sterilized before being used. The proper remedies may be obtained in tablet form, ready prepared for making solutions. The operator, before using the hypodermic solution, should see that no air is in the barrel, whence it may be driven into the circulation. This may be determined by holding the point of the syringe up after filling, and expelling the air by means of the piston.

Of course, every operation is inhibited during the existence of shock. It matters not what form it may take, whether that of increasing lethargy or growing excitement, the attention must at once be given to securing recovery. If indications of hysteria are observable, that may be one of the symptoms of excitable shock, and the patient should be given an anodyne and placed in a recumbent position in a quiet place, the operation, if it be dental, not to be resumed until another day.

No one suffering from any form of shock, the result of an oral operation, should be allowed for a moment to remain in the operating chair, as the recumbent position is the first essential. This does not seem to be properly appreciated by dentists. The extraction of teeth, especially when an anesthetic is administered, can be much better accomplished when the patient is lying down. A couch, specially adapted to the purpose, should be provided by those who give anesthetics for the extraction of teeth. The danger from administration is very materially lessened, while convenience in operating is proportionately increased. The couch should be about the height of a common table, and only wide enough easily to hold the patient. Standing on either side for upper teeth, and at the head in extracting lower ones, the operator has much better command of the situation and is less liable to fracture tooth or alveolus, while the chances of dropping a fragment into the trachea, or of choking the patient with blood, are very materially lessened. Recovery from anesthesia, and from the shock consequent upon the operation, are much more prompt and satisfactory. No general surgeon would for a moment even consider the question of operating in any case with the patient sitting up. Dentists should change their methods, and—at least in operations involving the administration of anesthetics and the extraction of a number of teeth—adopt a position that is surgically more appropriate.

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